Department for Business Innovation & Skills

RESEARCH

BIS RESEARCH PAPER NUMBER 294

UK Aerospace Supply Chain Study

JULY 2016

Contents

Executive Summary

The UK aerospace industry is a major world player and is a vital employer and wealth generator for the country. In 2015, the UK aerospace industry employed 116,000 people directly, and generated a revenue of nearly £29bn, £9.2bn of which was value-added revenue. Gross value added grew on average by 4% per annum between 2009 and 2015 (in real terms), compared with 2% for the manufacturing industry as a whole, and 1% for the whole economy[2]. Therefore, the continued success of the aerospace industry is of particular interest to the Government.

Increased global aviation traffic demand is expected to drive growth in the global civil aerospace sector in the medium-term, with forecasted demand equating to 33,000 new aircraft worth over $5 trillion up to 2034[1]. A highly-skilled workforce, institutional knowledge and a history of advanced technology has ensured the UK has a strong position in many current aircraft programmes. However, in order for the UK to secure a major stake in future aircraft programmes, the aerospace supply chain must continue to offer high quality products whilst being globally competitive. However, in spite of the strong historical position of the UK aerospace supply chain, current trends show that UK content on new aircraft is declining.

In light of this and the significant growth opportunities that exist, Government (led by the Department of Business, Innovation and Skills (BIS)), through its work with the Aerospace Growth Partnership (AGP), has initiated activities to maintain the UK's international competitiveness. Schemes such as the £3.9bn joint Government and industry investment in the Aerospace Technology Institute (ATI) demonstrate this commitment to the UK aerospace sector.

Whilst there is anecdotal evidence as to the reasons for the UK's declining market share and the various opportunities and challenges facing the UK aerospace supply chain, there is no consolidated source of information assessing both the structure of the UK aerospace supply chain and the views and opinions of key members of the supply chain. For this reason, Ricardo Energy & Environment was commissioned by BIS to perform a study aimed at furthering our understanding of the scale and scope of the UK aerospace supply chain, the structure of spending in the supply chain, connectivity between the companies and the issues they face as well as the opportunities and barriers to growth within the UK aerospace supply chain. The study ran from November 2015 to April 2016 and was closely supported by a Steering Group consisting of BIS, the ATI, the industry body ADS and a representative of the Regional Aerospace Alliances (RAAs).

The study consisted of three stages. Stage 1 followed on from a survey by BIS of a number of prime contractors and major Tier 1 suppliers with operations in the UK to secure information about their procurement spend and top suppliers. Ricardo Energy & Environment interviewed these companies, with the aim of gathering their views on the current strengths, weaknesses, opportunities and threats that face the UK supply chain.

---

[1] Flying High – One year on from Lifting Off (Aerospace Growth Partnership). Retrieved from http://www.theagp.aero/wp-content/uploads/sites/9/2014/07/AGP_Booklet_FINAL_FOR_WEB.pdf

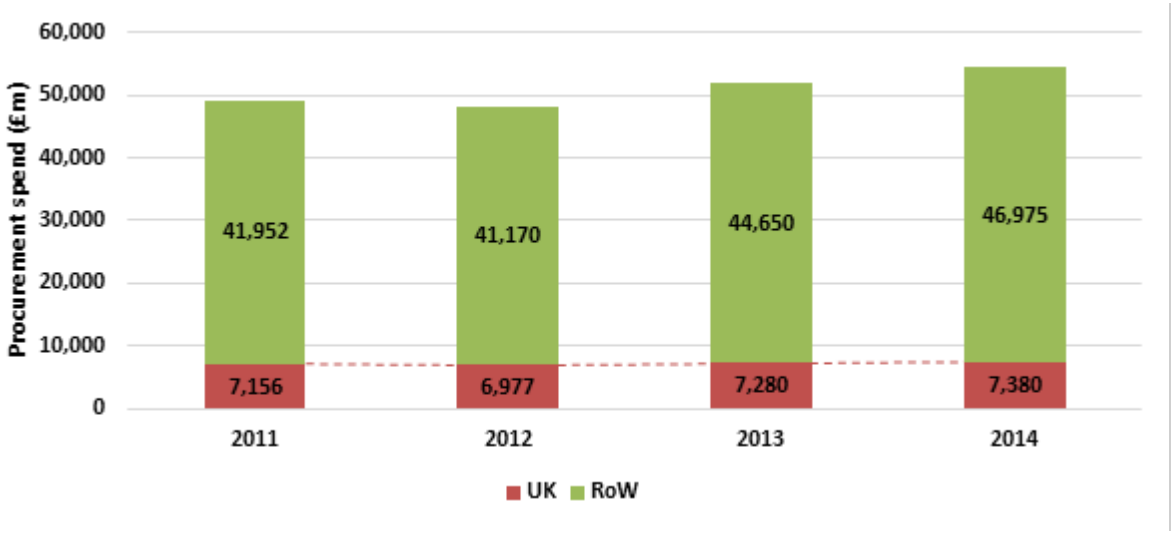
Stage 2 followed a similar approach, with interviews of additional key suppliers identified in Stage 1 (plus some smaller, lower tier suppliers to give balance to the outcomes).

Using the key themes identified from the Stage 1 and Stage 2 interviews, an online survey was distributed to over 1,000 aerospace companies within the UK supply chain. The aim of the survey was to gain evidence from the remainder of the supply chain as to whether their views corroborated or refuted the views of the interviewees. Supported by engagement by many members of the Steering Group, a strong survey response rate was achieved, with 148 and 88 completed and partially completed responses respectively, equating to a total response rate of 27%. Within this report, the prime contractors and key suppliers that took part in the Stage 1 and 2 interviews are referred to as interviewees, while respondents to the Stage 3 survey are referred to as the survey respondents.

The key themes that emerged from the study are as follows:

- **Whilst the UK aerospace industry is growing, it is not keeping pace with global growth.** Recent years show a reasonably healthy growth in procurement spend in the UK, with the analysis of the data from the prime contractors and major Tier 1 suppliers showing an increase of 1.4% from 2013 to 2014. Whilst this growth is certainly a positive for the industry, when compared to growth in procurement spend for the rest of the world (5.2%), it is clear that growth in UK spend is not keeping pace with global spend growth. This indicates that the UK is losing market share to overseas suppliers.

Figure E-1 - Procurement spend by prime contractors and major Tier 1s within the UK

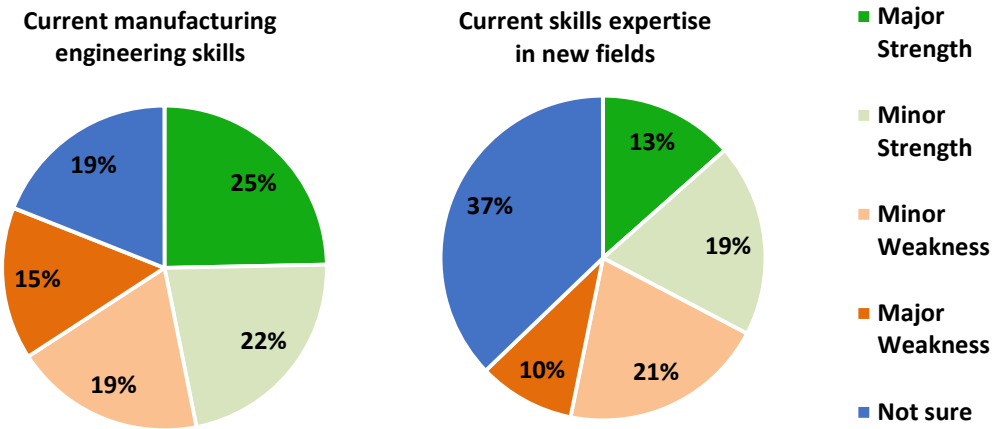


- **There is a shortage of skilled manufacturing and advanced technology skills in the UK**. The interviewees felt that whilst core aeronautical engineering skills are strong within the UK, there is a shortage of skilled manufacturing engineering and advanced technology skills. The interviewees highlighted that poor provision for these skills in education and a negative perception of careers in manufacturing may be contributing factors. Due to this lack of available talent, there is strong competition from the prime contractors and major Tier 1 suppliers and from other

industries that require similar skill-sets (e.g. automotive), further amplifying the problem. However, the opinion of the survey respondents was more mixed, with approximately equal numbers viewing these skills as being strengths and weaknesses for the UK. The reasons for this difference in opinion are not clear; however, it may be associated with a lower demand for advanced technology and manufacturing engineering skills in the lower tiers of the aerospace supply chain.

-

Figure E-2 – Opinions of the survey respondents on current skill levels in manufacturing engineering and advanced new fields



In addition to the shortages in skills, a number of technology areas were identified from all stages of the study where UK capability is either absent, or could be developed further. Most of the areas in which the UK supply chain is unable to provide sufficient capability to aerospace standards relate to processes and materials. In particular, capabilities in surface treatment, titanium machining, specialist wire and carbon fibre are seen as lacking in the UK supply chain. By contrast, there are almost no areas in which the UK is seen as lacking capability for propulsion and aero-structure parts.

Table E-1 shows the areas identified by interviewees or survey respondents where UK capability is either absent or could be developed further. Items in italics are those highlighted by the survey respondents, while the remainder were identified by the interviewees, or by both.

Table E-1 - Areas identified by interviewees and survey respondents as areas in which present UK capability is either absent, could be developed or is not competitive enough.

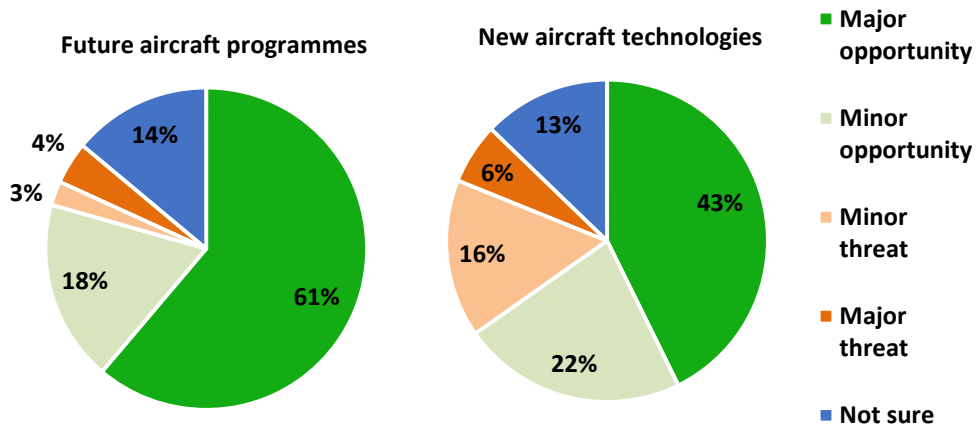
Systems and Equipment	Propulsion	Processes and Materials	Aero-structures	Other
• Actuation	• Fuel Systems	• Carbon fibre • Composite	• Bearings • Rotary	• Automated test

Systems and Equipment	Propulsion	Processes and Materials	Aero-structures	Other
• Air systems • Antennae • Electrical Power • Printed Circuit Board Assembly • Transmission systems • *Adapters*		manufacture • Dressings • Large forging and machining • Plating • Post-machining • Specialist resins (e.g. multi-functional epoxy) • Stress manufacture • Stretch forming • Surface treatment • Titanium machining • *Castings* • *Dyes* • *Material spray powder* • *Thermoset moulding materials* • *Vacuum melted steel and aluminium* • *Wire (specialist)*	wing supplier • *Extruded hose valves*	systems • Interiors • Test equipment • Tooling (e.g. jig fixtures)

- **New aircraft programmes and technologies can be major opportunities, but the UK may not be best positioned to benefit from such opportunities.** New aircraft programmes are likely to feature substantially different products, spurred in part by competitive dynamics, cost demands of airlines and the need to reduce the environmental impacts of aircraft. 79% of survey respondents viewed developing capability in new aircraft technologies and for future aircraft programmes as major opportunities for growth. However, the interviewees expressed concern that the UK supply chain is not currently well positioned to benefit from a major stake in any new aircraft programmes. They feel that major investments are required by UK-based Tier 1 suppliers and prime contractors, with the support of Government, into upgrading manufacturing capabilities. Additionally, they felt that some smaller suppliers lack the capabilities to access these opportunities through export markets.

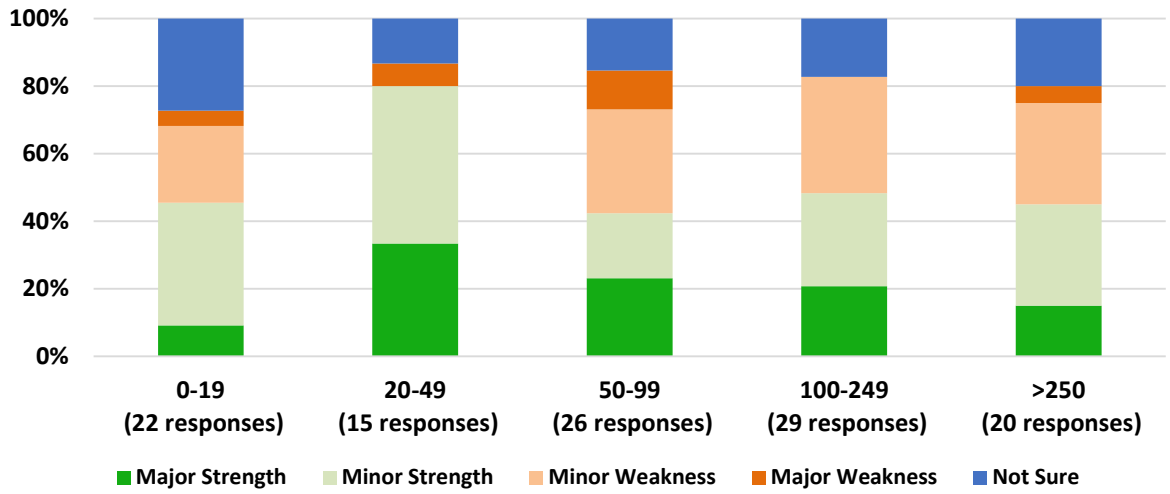
These results indicate a potential disconnect between the views of the interviewees and the survey respondents with regards to the opportunities presented by new aircraft programmes in particular.

Figure E-3 – Survey respondents' view of the opportunity and threats presented by future aircraft programmes and new aircraft technologies



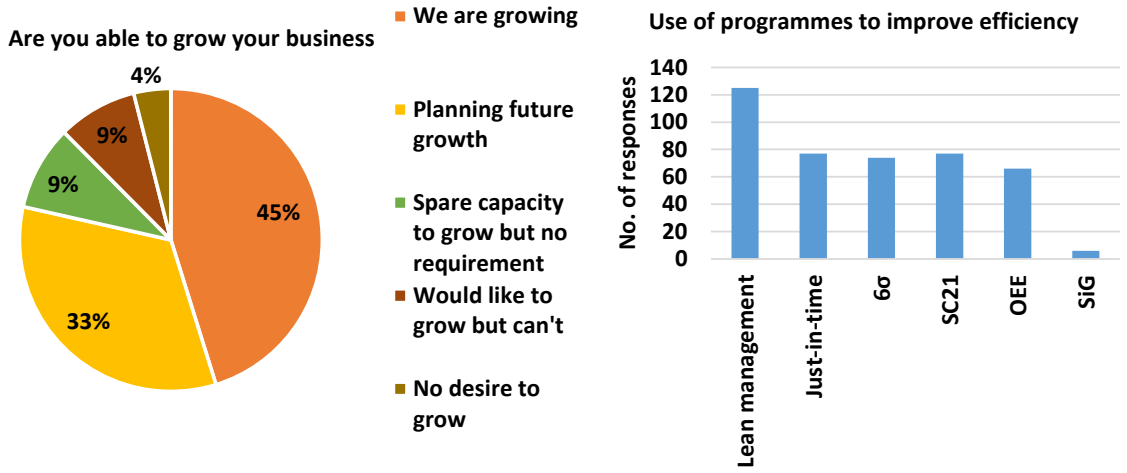
- **A lack of advanced manufacturing and lean supply chain management is leading to lack of global competitiveness**. The interviewees saw a lack of streamlined manufacturing processes and advanced supply chain management as weaknesses of the UK aerospace supply chain. In order to compete with low-cost emerging markets and highly-productive advanced economies, continuous improvements in quality and productivity are needed. The survey respondents' views were, again more mixed (particularly amongst smaller businesses who had a more positive view of their own manufacturing and supply chain skills), potentially highlighting a lack of awareness of the need for continuous improvement and adoption of advanced supply chain management and manufacturing capabilities amongst the lower-tiers.

Figure E-4 – Survey respondents' view of the use of the latest manufacturing engineering and supply chain processes



- **Lower-tier companies may lack the management structure and processes required to achieve growth**. The survey response indicates an ambitious UK supply chain, with 78% of respondents indicating that they are either already growing, or are planning future growth. This is in direct contrast to the view of many interviewees that many suppliers are either unwilling to grow, or lack the continuous improvement programmes necessary to effectively manage growth. The declining UK market share illustrated above also supports this more pessimistic view, with much of the growth in Prime contractor and Tier 1 purchasing going abroad. Indeed, only 53% of survey respondents indicated that they use at least one form of improvement programme for efficiency, supporting the interviewees' views on the lack of appreciation of the need for such programmes. The majority of suppliers that use improvement programmes implement more than one of these programmes, with 48% of all respondents using at least two improvement programmes. The interviewees also expressed the view that whilst improvement programmes, such as SC21, are highly beneficial for improving competitiveness, they are only a first step and follow-on programmes are required to achieve global excellence. Additionally, a lack of business acumen, supply chain management, support functions and sales and marketing strategy were identified as contributing factors to the apparent limited ability to grow within the lower tiers. It is likely that these apparent deficiencies are leading to the falling UK market share identified earlier; these results also support the view that there is a disconnect between the upper and lower tiers of the aerospace supply chain, as discussed earlier.

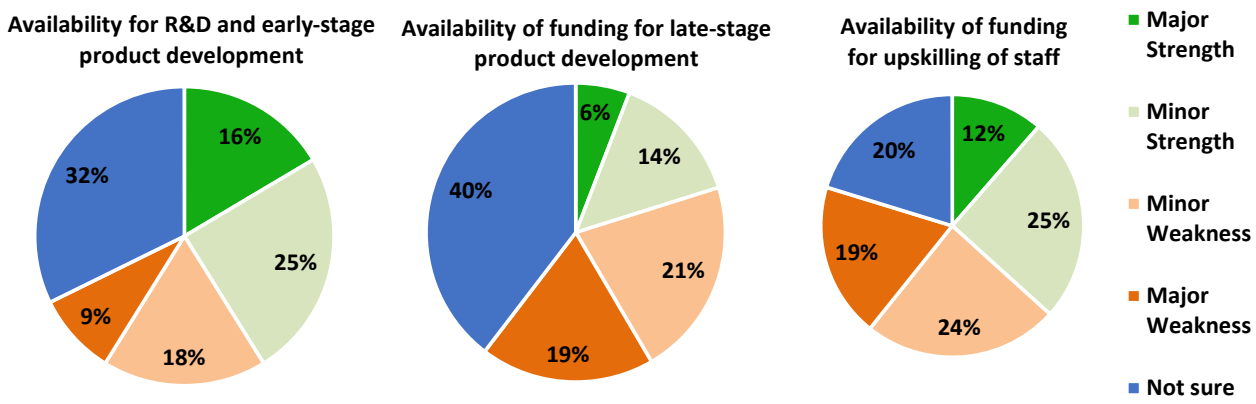
Figure E-5 – Survey respondents' view of their business growth and a bar chart illustrating the most common programmes used to improve operational efficiency



- **Prime contractors and lower tier suppliers have different views on the barriers to growth in the global market**. Again, this aspect of the interviews and survey respondents supports the apparent disconnect between the views of the upper and lower tiers of the UK aerospace supply chain. The results of the survey indicate that the main barriers to growth for the UK aerospace supply chain are the length of contracts with prime contractors and the availability of skills and training. In particular, the respondents were asked about the procurement behaviour of major companies and this was found to be a major weakness for the supply chain. Demanding contractual terms and conditions and payment structures were also highlighted as problematic. The interviewees recognised the impact of their complex procurement processes, but did not see them changing in the near term. They instead identified the other issues, as outlined above, as the main barriers to growth within the lower tiers.

- **Strong support is available for early-stage product development, but less for late-stage development.** Interviewees felt that Government support for early-stage product development, from initial research and technology demonstration through to initial prototype, is readily available. However, they felt that funding sources for late-stage product development and production investment was lacking. The survey respondents tended to agree with these opinions, although a large proportion of "not sure" responses may indicate a lack of awareness of opportunities for support. Interviewees also consider funding for the upskilling of staff and training as readily available. However, competition for, and the complexity of accessing these funding streams for upskilling the workforce led to a more mixed response from the survey.

Figure E-6 – Survey respondents' view of the availability of funding for research and development, and early-stage product development, late-stage product development, and upskilling of staff



Overall, the outputs from the consultation indicate reasonably strong growth in the UK aerospace supply chain and an optimistic view of future growth for lower tier suppliers. However, there is a clear difference of opinion between the developments that the prime contractors and major Tier 1 suppliers consider are required to access the major growth opportunities identified and the apparent capabilities and plans of the lower tier suppliers. This is contributing to a reducing UK share of the global aerospace supply chain market in the face of lower costs and higher productivity in many emerging and advanced economies and a strong willingness for some overseas governments to invest in this area.

Introduction

Context

The UK aerospace industry is an important wealth generator and employer in the UK. In 2015, aerospace industry in the UK employed 116,000 people directly, and generated a revenue of nearly £29bn, £9.2bn of which was value added. Gross value added has grown on average by 4% per annum between 2009 and 2015 in real terms, compared to 2% for manufacturing and 1% for the whole economy[2]. Internationally, the UK has a significant share of the global market, making it the leading aerospace manufacturer in Europe, and second only to the USA worldwide.

A highly-skilled workforce, historical institutional expertise and an advanced science and research base has ensured the UK has a strong position in many current aircraft programmes. This success draws heavily on the investment made in developing technologies in the 1970s and 1980s, and the UK now considers itself to be at the forefront in three high-value, highly complex areas of modern aircraft; engines, aero-structures and advanced systems.

Looking to the future, the forecasted increase in global air traffic demand of 4.6% per annum up to 2034[3] will drive growth in the global civil aerospace sector in the medium-term. Globally, this growth equates to 33,000 new aircraft worth over $5 trillion[4]. One of the biggest issues facing Original Equipment Manufacturers (OEMs) in order to deliver this growth whilst maintaining competitiveness is the management of their supply chains. The aerospace industry is highly consolidated; there are relatively few customers, each with complex and interdependent supply chains. Increasing customer demands require improved cost- and time-efficiency within the supply chain, without compromising on the stringent quality requirements characteristic of the aerospace industry. Additionally, OEMs must ensure that their suppliers are capable of increasing capacity, so that their processes are not disrupted by a supplier unable to cope with upscaling throughput. Overall this is leading to an increasingly consolidated supply chain, with fewer, but more global suppliers supporting new aircraft programmes. To add to the complexity of this transition, OEMs must achieve this consolidation and growth whilst at the same time developing and incorporating new technologies and materials into their designs, spurred in part by competitive dynamics, the cost demands of airlines and the need to reduce the environmental impact of aircraft.

Clearly the above trends represent a significant opportunity to the UK aerospace supply chain going forward. However, a number of challenges must be addressed in order to access these, and other major growth opportunities. Indeed, in spite of the current strong position of the UK aerospace industry and the various initiatives highlighted above, current trends show that UK content on new aircraft is in decline.

---

[2] National Accounts data published by the Office for National Statistics
[3] Airbus Global Market Forecast – Flying by Numbers – 2015-2034
[4] Flying High – One year on from Lifting Off (Aerospace Growth Partnership). Retrieved from http://www.theagp.aero/wp-content/uploads/sites/9/2014/07/AGP_Booklet_FINAL_FOR_WEB.pdf

In light of this and the major growth opportunities identified, the UK Government (led by the Department for Business, Innovation and Skills (BIS)), through its work with the Aerospace Growth Partnership (AGP), has sought to maintain the UK's international competitiveness. The AGP is a collaborative partnership between industry and Government, whose scope is civil aerospace – from business jets and helicopters, to the very largest commercial jet aircraft – with the aim of ensuring that Government and businesses work together to understand the opportunities, threats and barriers to growth, and to identify the areas where Government can help create a sustainable, long-term future for the industry.

The inception of the AGP in 2010 has led to an improvement in the relationship between Government and industry, with the adoption of a more holistic industrial strategy. Recent initiatives reflect this stance. For example, Government and industry have been investing in research and development, leading to the creation of the UK's Aerospace Technology Institute (ATI). Government and industry have jointly committed £3.9bn funding to this priority, equating to £150 million annual Government funding, matched by industry, committed to 2026. The strategy behind setting up the ATI is to maintain a competitive edge in the UK by developing key technologies which make aircraft quieter, more energy efficient and cheaper to manufacture and operate, focusing on technological advancement in the areas in which the UK already has capability.

Additionally, other schemes, such as supporting the Sharing in Growth (SiG) organisation through Regional Growth Funds, funding of the National Aerospace Technology Exploitation Programme (NATEP), introducing a £6m bursary to fund 500 new graduates and employees to study Masters (MSc) level degrees in aerospace engineering, and through greater collaboration within the supply chain.

Whilst there is anecdotal evidence as to the reasons for the declining UK content on new aircraft and the various opportunities and challenges facing the UK aerospace supply chain, there is no consolidated source of data on the structure and interactions in the supply chain, or information assessing the views and opinions of key members of the supply chain with respect to growth opportunities and associated barriers. Therefore, it is necessary to develop a clear understanding of the UK aerospace supply chain today, in terms of its structure, the flow of value and the opportunities and challenges that are perceived by its stakeholders. With this intelligence, BIS, the AGP, the ATI, ADS and the various Regional Aerospace Alliances (RAAs) will be able to ensure that their activities are optimised to support their long-term industrial vision in order to sustain and grow the UK aerospace industry.

For this reason, BIS commissioned Ricardo Energy & Environment to perform a study looking into the structure of, and issues and opportunities associated with, the UK aerospace supply chain. The study ran from November 2015 to April 2016 and was closely supported by a Steering Group consisting of BIS, the ATI, industry body ADS (Aerospace, Defence, Security) and a representative of the RAAs. Throughout the study, the Steering Group met monthly in-person, in addition to a number of ad-hoc teleconferences to discuss various aspects of the survey design, survey response rates and the outputs from the interviews and survey. A draft final report was discussed at a workshop consisting of the Steering Group and a number of additional key stakeholders before the preparation of this document, the final study report.

Scope of the Study

For the purposes of this study, the UK aerospace supply chain was identified as all organisations in the UK who contribute to the design, production and supply of flying parts for civil aircraft (fixed wing and helicopters). The scope of the study therefore excludes:

- Parts specifically for military aircraft (which is out of the scope of the AGP).
- Maintenance, Repair and Overhaul (MRO) operations (which was covered by an earlier BIS report).

Methodology overview

The methodology of the project can be summarised as a three stage process:

- **Stage 1**: Stage 1 followed on from a series of surveys which were sent to a number of prime contractors and major Tier 1 suppliers[5] operating in the UK by BIS (including some headquartered in the UK and overseas), to secure information about their procurement spend and top suppliers. The results of the BIS survey were aggregated and anonymised before they were handed to Ricardo Energy & Environment for analysis. Ricardo Energy & Environment followed up with these Prime contractors and major Tier 1 suppliers and requested interviews with each of them. The aim of these interviews was to gather the views of major aerospace companies on the current strengths, weaknesses, opportunities, and threats that face the UK supply chain. These interviews took the form of a semi-structured discussion which covered topics including labour force, technological and material capabilities within the UK and the competitiveness of the UK supply chain globally. During these interviews, prime contractors also suggested key Tier 1 suppliers and SMEs to approach for Stage 2 interviews. The output of this stage was a series of SWOT (Strength, Weaknesses, Opportunities, and Threats) analyses for each company interviewed. Later this information was aggregated and anonymised into a series of SWOT analyses covering a number of overarching themes coming out of the discussions – these are discussed in more detail in the "Barriers and opportunities" section.
- **Stage 2:** Stage 2 followed a similar methodology to Stage 1, with discussions with key suppliers following the same semi-structured format as with the prime contractors. The output of the discussions, as with Stage 1, was a series of SWOT analyses for each company interviewed. This information was also aggregated and anonymised into the overarching SWOT themes developed for the Stage 1 interviews. These key suppliers were also asked to complete a quantitative survey which assessed cash-flow through the supply chain, in order to assess its connectivity and the areas where value is added by the UK supply chain, as well as where the opportunity to add value is lost due to imports. The

[5] The definition of a prime contractor varies significantly. Here, the definition is that the prime contractors are corporations that take on the total responsibility of a given project, and whose customers are the aircraft operators (airlines) or the airframe manufacturers.

results of this quantitative survey are included with the results of the Stage 3 survey.

- **Stage 3**: The final stage of the project was to develop a survey to be sent to a wide range of UK aerospace companies who had not already been interviewed. The survey was structured into two broad sections; a quantitative and a qualitative section. The quantitative section was very similar to that sent to the key suppliers in Stage 2, and aimed to gather the same information. The qualitative section was based on the over-arching themes that were observed from Stage 1 and 2. The survey was sent to 884 companies, drawing from contacts provided by ADS and the RAAs. In addition, one of the RAAs distributed the survey invitation to their members directly, bringing the total number of companies invited to participate to over 1,000. Active communication and promotion of the survey and the study by all partners in the project supported achieving a high response rate to the survey (27%). The results from the survey were then aggregated, anonymised and analysed, as described below, to determine trends, and areas where the supply chain corroborates or refutes the opinions of the prime contractors and Stage 2 interviewees.

In the remainder of this report, Primes and key suppliers that contributed to Stage 1 and 2 of this study are referred to as “interviewees”. Respondents to the online survey carried out in Stage 3 are referred to as the “survey respondents”. The respondents to the survey originally conducted by BIS are referred to as “Primes and major Tier 1 suppliers”.

Further details of the methodology are given in Appendix 1 “Detailed description of methodology”.

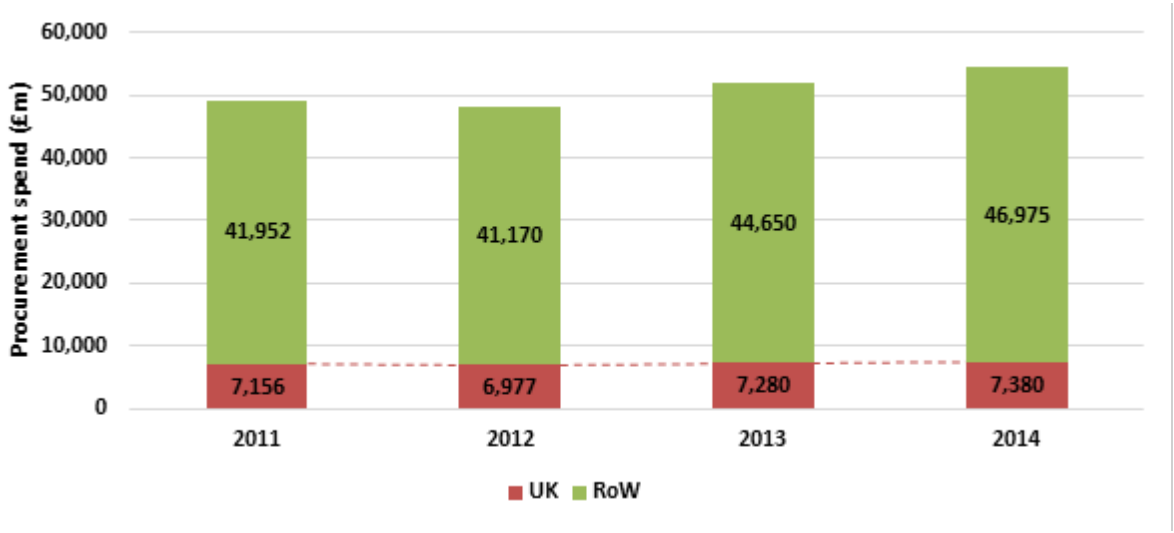
Structure and Value of the Supply Chain

Primes views

As a precursor to Stage 1 of this study, BIS asked a group of prime contractors with significant operations in the UK to complete a survey which captured their quantitative procurement spend both within the UK and globally and qualitative comments on the UK aerospace supply chain. The aggregated and anonymised results of this survey were provided to Ricardo Energy & Environment for analysis.

In general, the results from this analysis indicate that the total spend with UK-based suppliers for prime contractors with a presence in the UK is increasing, with approximately £7.3bn[6] spent by prime contractors in 2014 with UK-based suppliers. Whilst this paints a positive picture and is consistent with the general trend of growing demand in the civil aerospace sector, when compared to the growth rate of procurement spend worldwide, growth in UK spend does not compare favourably, as illustrated in Figure 1. Since 2012, the disparity between the growth rates has been rapidly increasing, and in 2014 the growth rate worldwide was more than triple that seen in the UK, standing at approximately 5.2% for rest of world spend growth compared to around 1.4% for UK spend growth. Clearly this is indicative of a potential missed opportunity which may be explained by some of the issues highlighted in “Barriers and opportunities”, below.

Figure 1 - Total procurement spend by Prime contractors and major Tier 1s for the UK and the rest of the world



[6] Note that this figure represents a maximum estimate, since the results do not account for inter-Prime spending. As a result, total spend in the UK supply chain may be lower than this.

By disaggregating total prime contractor spend by product type, the results provide convincing evidence of the dominance of two markets within the UK supply chain, namely propulsion and aero-structures, as illustrated in Figure 2. Indeed in 2014, the procurement spend within the UK for propulsion and aero-structures was at least £2.5bn and £1.3bn respectively[7], making up over 84% of total UK spend. Figure 3 illustrates the breakdown of spend by region and product type, with other major supplier regions including the rest of Europe and North America.

When illustrated as a percentage of total spend in each product category however, UK spend in the four major product categories presents a consistent picture, accounting for a significant 25-40% of total global spend by the UK-based prime contractors for systems and equipment, propulsion, processes and materials, and aero-structures respectively, as shown in Figure 3:

- The UK's most dominant contribution is in the aero-structures category, with 38% of total global spend, with the rest of Europe making up the vast majority of remaining spend in that category.
- For propulsion, the UK's contribution stands at 26%, with a significant contribution from North America (19%) and the remainder from the rest of Europe.
- A similar picture (28%) to propulsion is seen in the Systems/Equipment category, with a smaller 11% contribution from North America.
- The picture is somewhat different in the Processes and Materials product category however, with 29% supplied by the UK, a much smaller 14% supplied by the rest of Europe and over 50% of total prime contractors' spend in North America, Asia and the Middle East, illustrating a leading offering from these regions in this product category.
- The procurement spend by the prime contractors with North American suppliers seems surprisingly low overall given the fact that the USA is the leading aerospace supplier globally, indicating a bias towards the UK and Europe in general. This may reflect some differences in interpretation of the BIS survey; for example, some may have included procurement spend only by their UK-based operations, while some may have included their global operations.

[7] As with the total spend figures, these numbers should be treated with caution. These figures are derived solely from the top 10 UK and top 10 RoW suppliers of each respondent, and so provide a minimum estimate. Additionally, in some cases, responses did not provide data of spend by supplier, and hence procurement by product type could not be ascertained.

Figure 2 – Split of UK procurement spend by product category in 2014 by primes and major Tier 1 companies

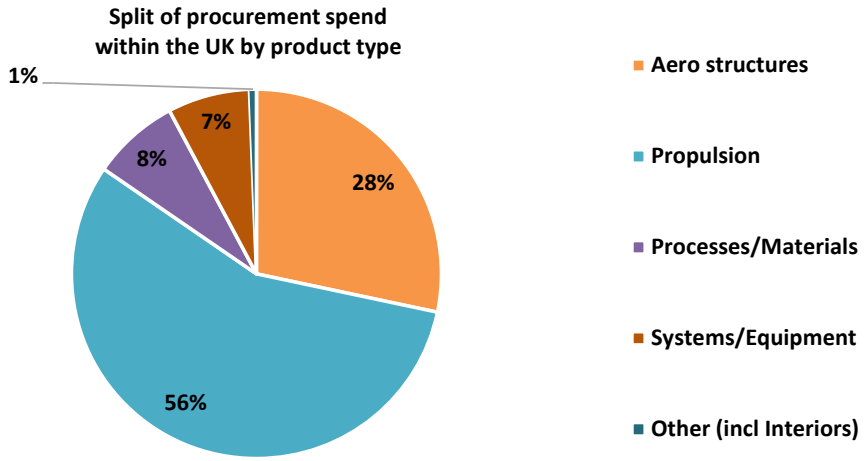
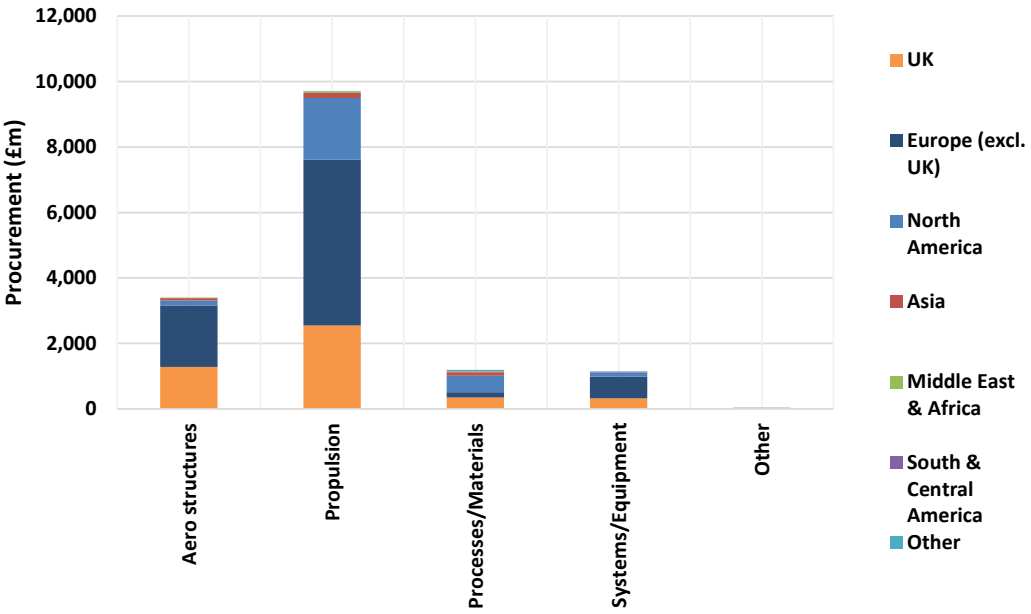


Figure 3 - Spend of primes and major Tier 1 companies for each region, including only their top 10 suppliers



Supply chain view

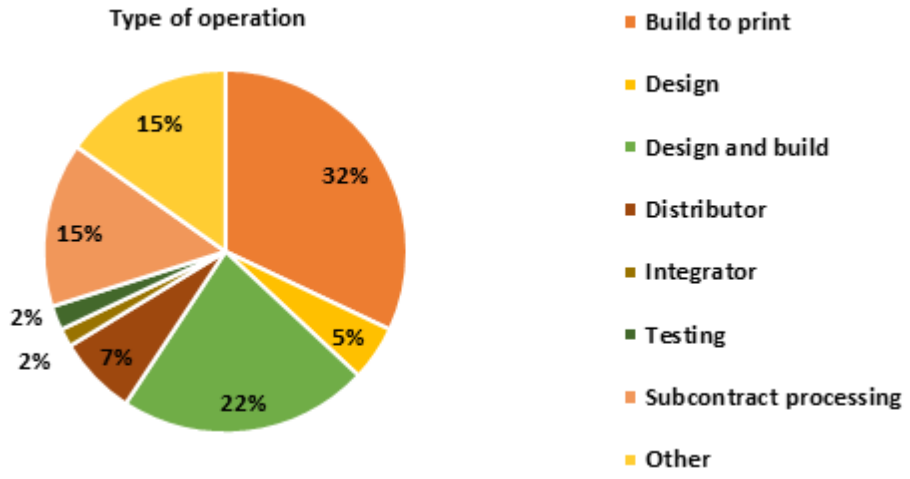
Participant company overview

Nearly 60% of survey respondents considered their operations to be primarily ‘build to print’ (32%), ‘design and build’ (23%), or ‘design’ (4%). The large proportion of ‘design and build’ and ‘design’ companies lends support to the view amongst interviewees that customers are now looking to consolidate their supply chain through using fewer suppliers

with wider capabilities, and they are subsequently requiring these suppliers to design their own integrated products for the end-customer based on customer specifications.

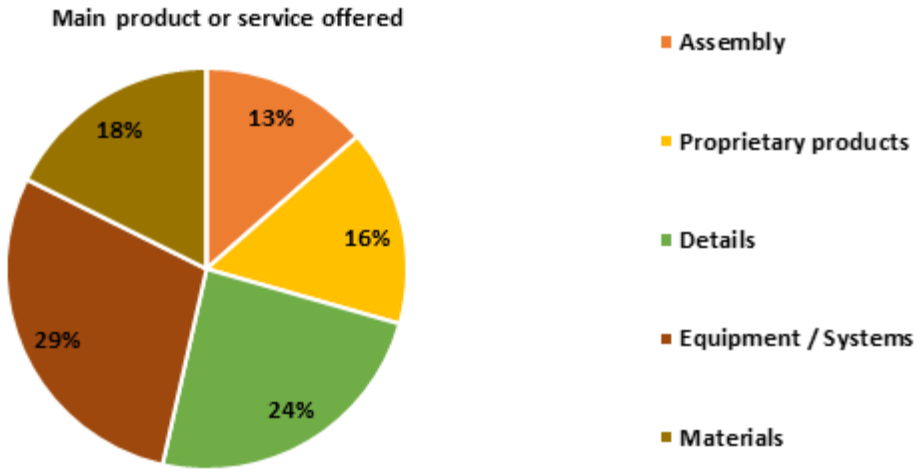
Approximately another 40% of survey respondents fell under the ‘distributor’, ‘integrator’, ‘subcontractor processing’ or ‘testing’ categories, as illustrated in Figure 4. Only 15% were classified under the ‘other’ category, with respondents stating their main areas ranging from component manufacturers to management consultancies. After further investigation, 8% of survey respondents were considered to be outside the core scope of the study, i.e. those companies who contribute to the design, production and supply of flying parts for civil aircraft. These responses were isolated and removed from any subsequent analysis.

Figure 4 - Illustration of the type of business operation of the companies who responded to the survey



With regards to product type, the survey respondents cover a fairly even split of companies across the various product types considered, as illustrated in Figure 5 below (note that no respondents selected the “Other” category).

Figure 5 - Illustration of the results of the survey regarding the main civil aerospace product or service that each organisation offers



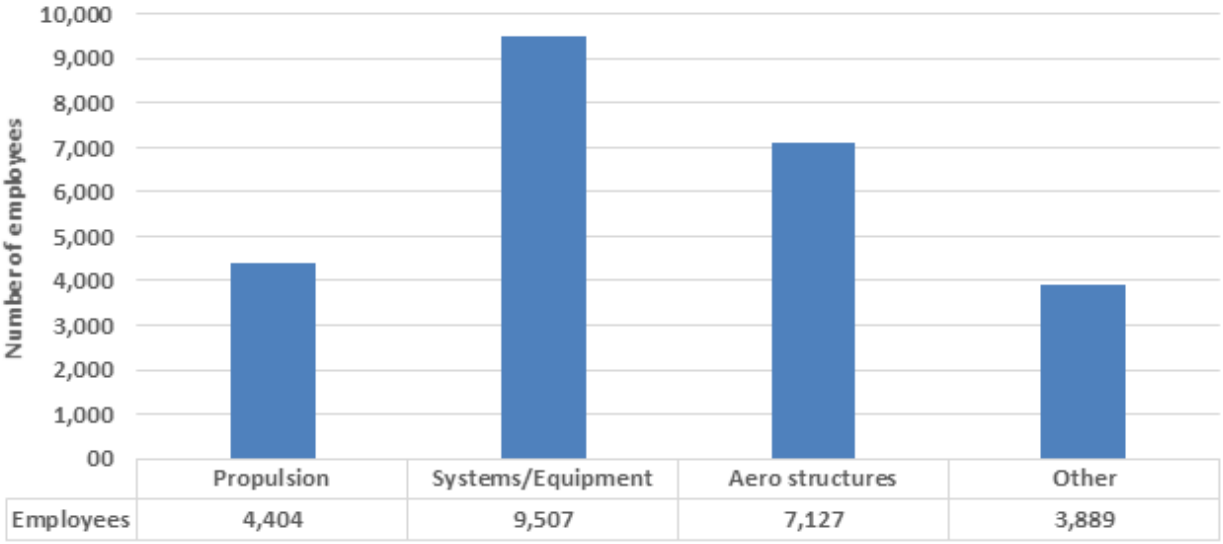
Employment

The survey captures companies with over 27,000 full-time equivalent (FTE) employees, while the ONS figure for direct aerospace employment in 2015 is 116,000[8], although this figure includes those who fall outside of the scope of this project (e.g. MRO) as well as prime contractor and Tier 1 employees that were not covered by the survey. It should be noted that ONS figures do not differentiate between civil and defence aerospace, and so direct civil aerospace employment is likely to be less than the statistic presented above.

It is possible to disaggregate employment by product category, and the results indicate a fairly similar distribution to those described in Appendix 2 “Consistency of the online survey with National Statistics”, where turnover is also split by product category. Both propulsion and aero-structures comprises a large number of the employees captured by this survey. In contrast to the findings from the prime contractors’ survey, however, the number of employees at systems and equipment companies is even larger. The reason for this discrepancy remains unclear, but may relate to a bias in the survey where companies who produce systems and equipment are over-represented.

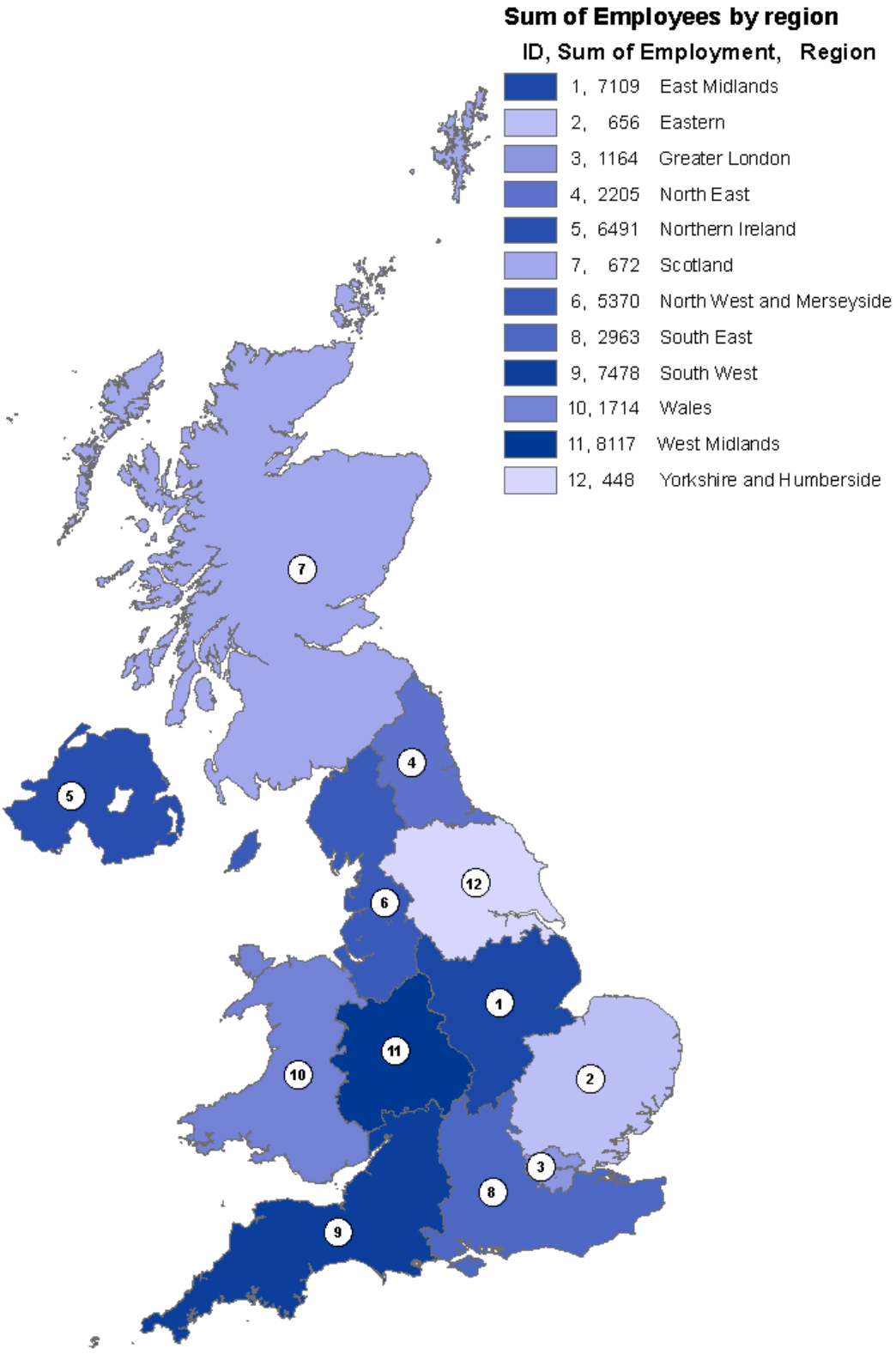
[8] “Annual Business Survey”, Office for National Statistics, 2015

Figure 6 - Number of employees disaggregated product type



Employment may also be disaggregated by region, as illustrated in Figure 7. The regions with the highest number of employees were the West Midlands, South West and East Midlands, broadly mirroring known aerospace clusters around the UK. Areas where employment figures are lowest are in Scotland, East of England and Yorkshire and Humberside, which is also reflective of the number of respondents from each of these regions, as illustrated in Figure A-3.

Figure 7 – Number of employees by region from survey responses



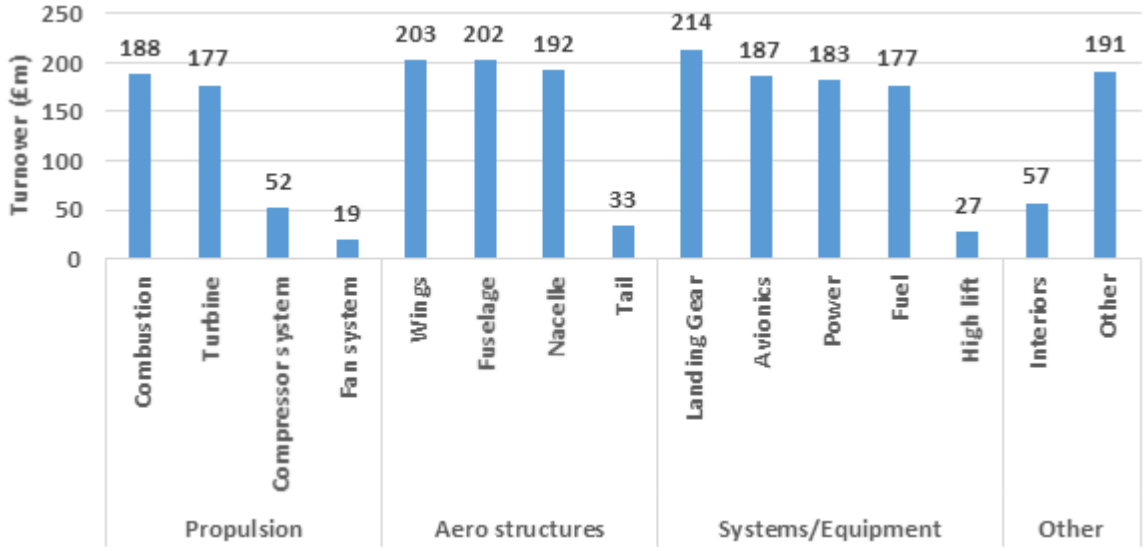
Turnover and procurement spend

As discussed in the Primes views section above, the quantitative responses to the survey sent to prime contractors by BIS indicate a total of £7.3bn of UK-based procurement spend. However, the amount that reaches the supply chain itself is likely to be less than this, since this is inclusive of inter-prime expenditure, and hence there will be significant double-counting. Nonetheless, this figure helps to provide a first-order metric of the coverage that the online survey has achieved, by comparing total UK-based procurement by prime contractors and the same figure for the respondents to the survey.

The analysis of the data provided indicates that sales within the UK account for about £1.2bn. Therefore, the survey captures approximately 16% of the £7.3bn prime spending in the UK discussed above. Since double-counting in the prime contractors response has not been removed, this may be treated as a lower-bound estimate as to the extent of the coverage of the UK aerospace supply chain that the survey responses have achieved. However, inter-supplier expenditure may also be present, and without more detailed information on procurement, it remains impossible to remove the uncertainty from this.

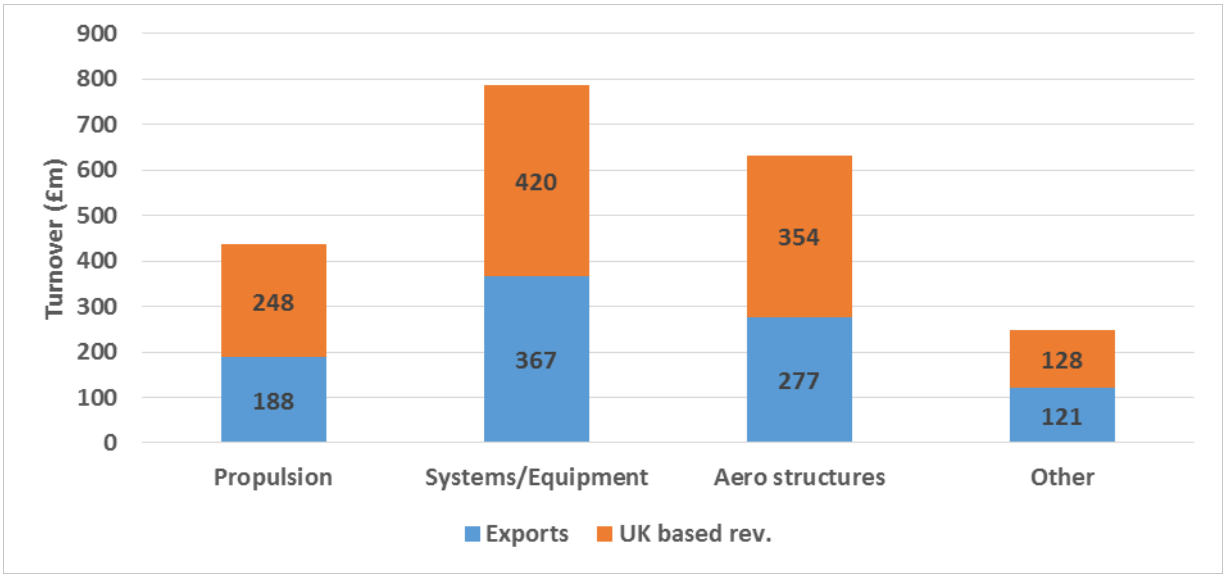
The turnover coverage can be further disaggregated by where the product is incorporated on an aircraft, as illustrated in Figure 8**.** Since the survey gave the option to select multiple responses to this question, it has been assumed that turnover is split evenly across each response. For example, if a company supplies parts that are incorporated into both combustion and fuel, then its turnover is split evenly between the two.

Figure 8 - Disaggregation of turnover by where the product is incorporated on aircraft, a total of 171 responses



If, like employment, these results are aggregated into four main product categories used in the prime contractors' survey responses, then the same distribution and discrepancies emerge. As before, both propulsion and aero-structures remain a large share of total turnover for the UK supply chain, but an over-representation of systems and equipment producers is apparent. This is the case for turnover related to both UK supplies and exports, as illustrated in Figure 9.

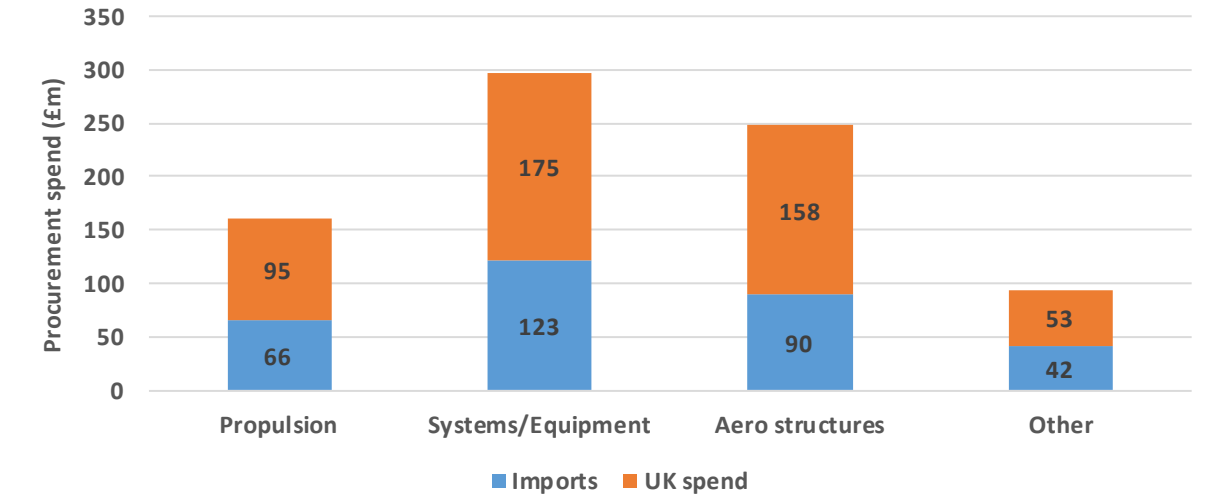
Figure 9 - Turnover and exports captured by the online survey, where only responses with complete quantitative sections are considered, a total of 88 responses



For each product category, as defined by the BIS quantitative survey, the share of total turnover due to exports is approximately the same (around 45%).

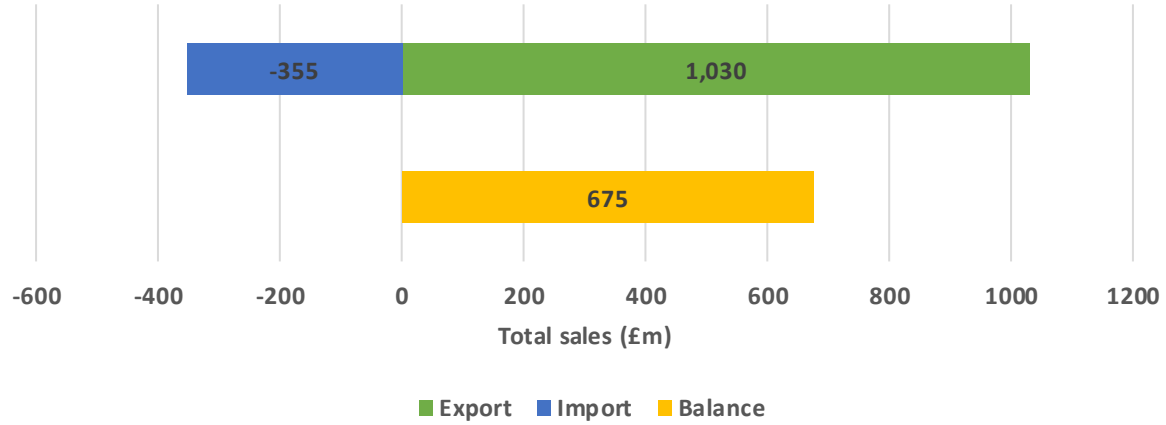
Procurement spend captured by the survey totals £1.0bn, when only the surveys with complete quantitative sections are considered (£2.3bn otherwise). Of this, £360m was spent on imported products, i.e. 36%. As with turnover and exports, when these figures are disaggregated by product category, a similar distribution emerges; the dominance of systems/equipment, followed by aero-structure and propulsion peaks. When imports are expressed as a percentage of procurement spend for each product category, there is little variation, indicating that both imports and domestic supply chain spend follow a similar distribution to total procurement spend.

Figure 10 - Procurement spend from the online survey, where only surveys with complete quantitative sections are considered, a total of 88 responses



In general the trade balance between imports and exports is strongly positive, to an even greater degree than that suggested by data from the Office of National Statistics (ONS), which shows that export sales were 17% greater than import spend in 2014[9], although these figures do include both civil and defence aerospace markets. The figures from the survey show that export sales are approximately 1.9 times larger than import spend in the financial year 2014-15, as shown in Figure 11. The reasons for the differences from the ONS results are not clear, though it may be indicative of a self-selection bias in the responses, in that companies who are successful in the global marketplace may have been more likely to respond to the survey than those with a very UK-centric viewpoint.

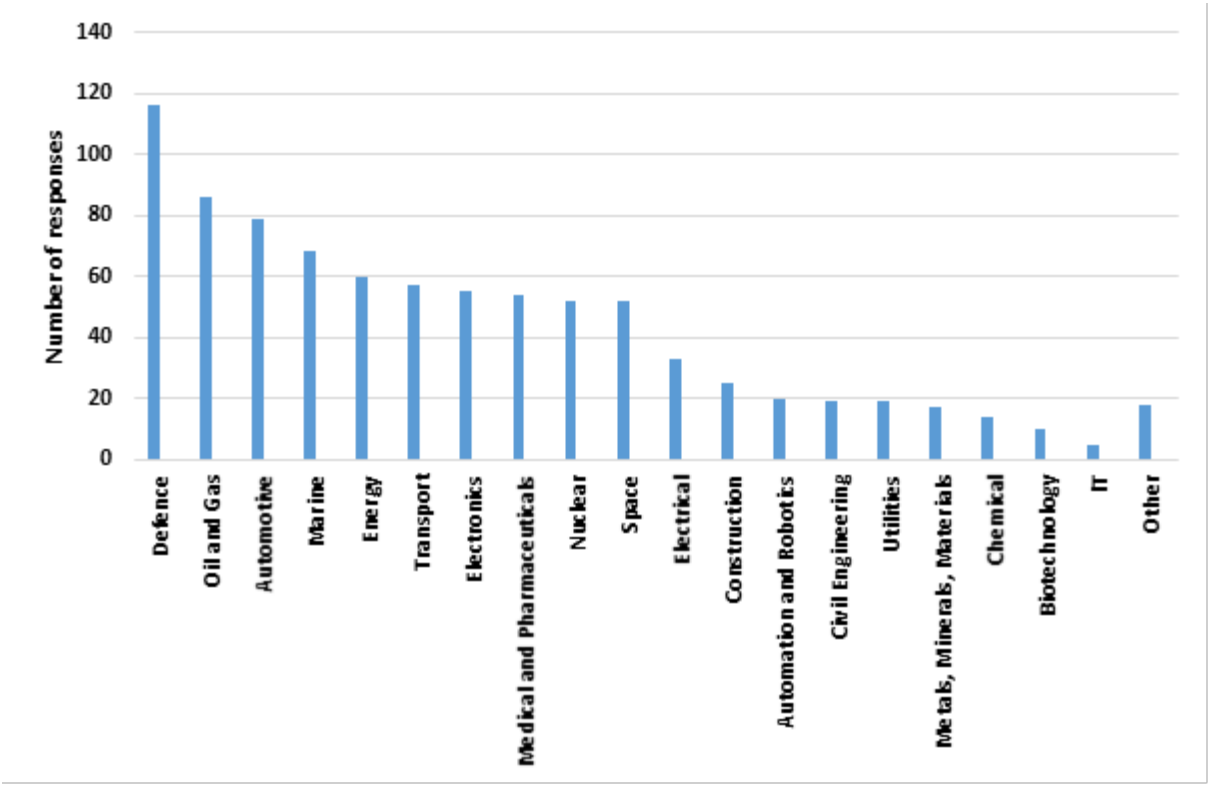
Figure 11 - Trade balance between imports and exports from the online survey, where only responses with fully complete quantitative sections are considered, a total of 88 respondents.



The survey also captures the other sectors in which the respondents sell products, beyond the aerospace supply chain. The results show that nearly all respondents who completed the quantitative section supply other sectors, as shown in Figure 12. The most frequent other sectors supplied are defence, oil and gas, and the automotive sectors, illustrating a strong overlap between the supply chains for these sectors, which require similar technologies, materials and parts as the aerospace industry.

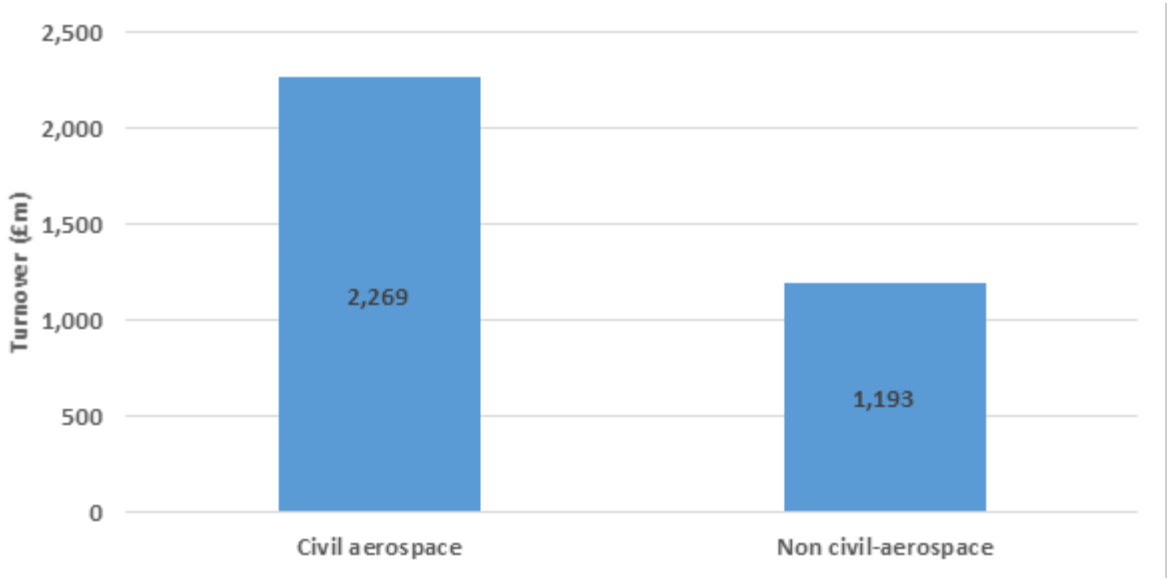
[9] Office of National Statistics aerospace statistics - 2015.

Figure 12 - Number of respondents who indicated they also worked in further industries



When the turnover of survey respondents is broken down between civil aerospace and non-civil-aerospace, it is apparent that whilst turnover from non-civil-aerospace is substantial (34% of total turnover) and many suppliers therefore have some resilience to fluctuations in the civil aerospace industry, the success of these companies is nonetheless closely linked to the success and strength of the civil aerospace industry. Based on the 88 survey responses received that included full answers to the quantitative section of the survey, £2.3bn of turnover is captured, whilst non-civil-aerospace turnover for these respondents totalled £1.2bn.

Figure 13 - UK turnover of respondents from civil aerospace and non civil-aerospace sales[10]



Materials used

The survey respondents indicate that most use primarily metallic materials for their products. This is reflective of the opinions expressed by the interviewees (see “Education and training in new technology areas”), which suggest that the UK has strong capabilities in metallic materials, but that capability in composite materials is more limited. In spite of this, the turnover generated by companies using composite materials is much higher than those using metallic materials. This may be interpreted in a number of ways. Firstly, this may indicate that there is significantly more value in developing composite capabilities. Whilst composite use will become more widespread in future aircraft programmes and is likely to be more valuable, it seems unlikely that this can account for the entirety of the discrepancy. Instead, it may reflect the size of the companies who have developed this capability. Larger companies are more likely to have sufficient capital to cover the upfront costs of developing new technological capability to a competitive standard, whereas smaller companies may find funding these investments more difficult, and so remain metallic-only users. This is supported when employment by material type is considered. The number of employees at companies who use mixed metallic / composite materials is much greater than solely metallic.

[10] In some cases, civil aerospace turnover was not provided by the respondents, yet turnover for UK sites was. In these cases, civil aerospace turnover was assumed to be equally split between all sectors the response indicated

Figure 14 - Reponses to the online survey illustrating the share of companies by primary material types used.

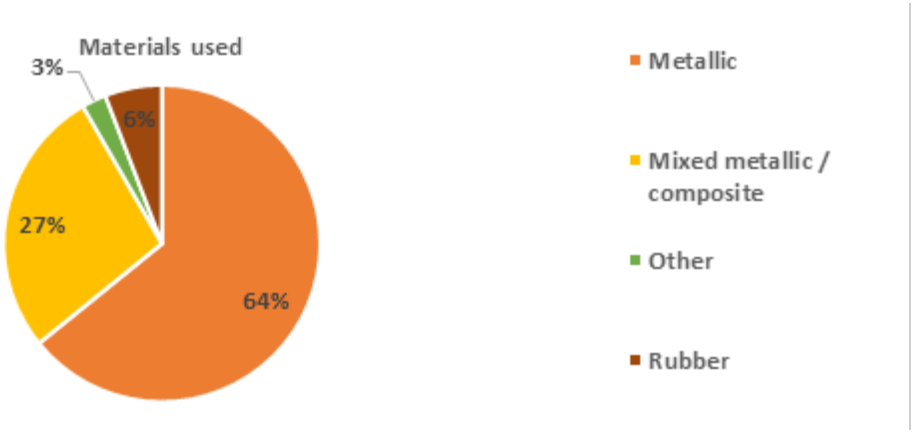
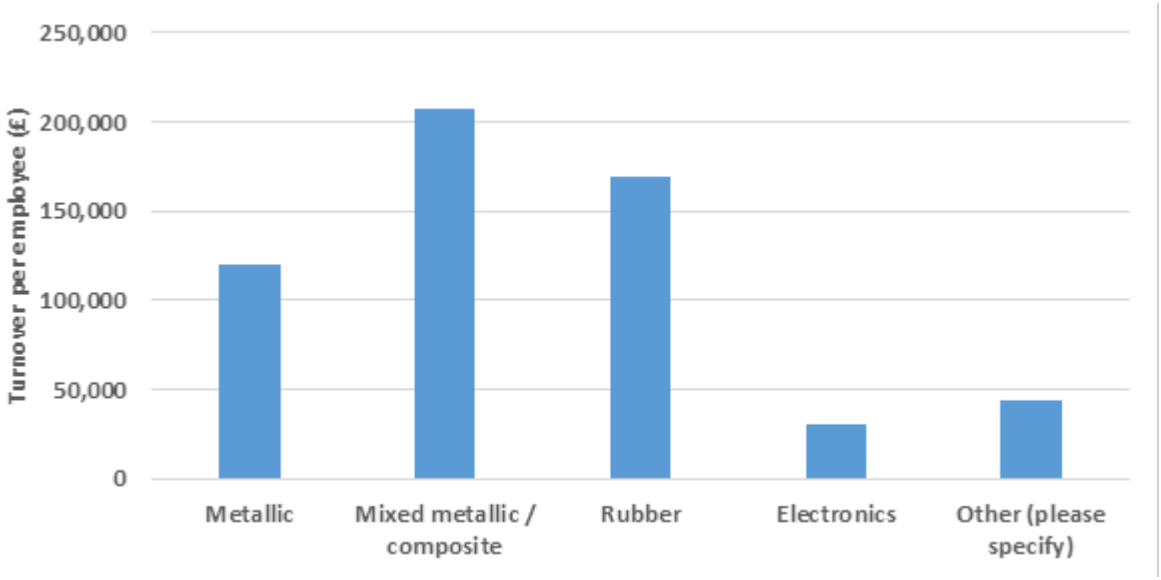


Figure 15 - Turnover per employee per material type



Barriers and Opportunities

Introduction to SWOT analysis

The responses of the interviewees were categorised into a series of over-arching themes which capture the most prominent views and opinions discussed. These themes are aligned with a number of the AGP working group focus areas, as summarised below:

- Theme 1: Labour force (Skills AGP working group)
- Theme 2: Technology and material availability (ATI)
- Theme 3: Supply chain interactions (Supply Chain and Manufacturing AGP working groups)
- Theme 4: Government engagement (Strategy and Engagement AGP working groups)

For each of the above themes, an individual SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) was produced to represent the views of the interviewees (these are found in Appendix 3 “Complete SWOT tables”). Each key point from the interviewees highlighted under the various themes was then compared to the results from the qualitative section of the online survey. In doing so, the views and opinions of the prime contractors and the key suppliers (who made up the majority of interviews) could be compared and contrasted against those from the wider UK aerospace supply chain (who made up the majority of the survey responses), to identify areas of agreement or where there were any clear disparities of opinion.

Theme 1: Labour force

Views expressed by the interviewees were fairly consistent with respect to the labour force and skills availability in the UK aerospace supply chain, with some areas viewed as strong and others weaker.

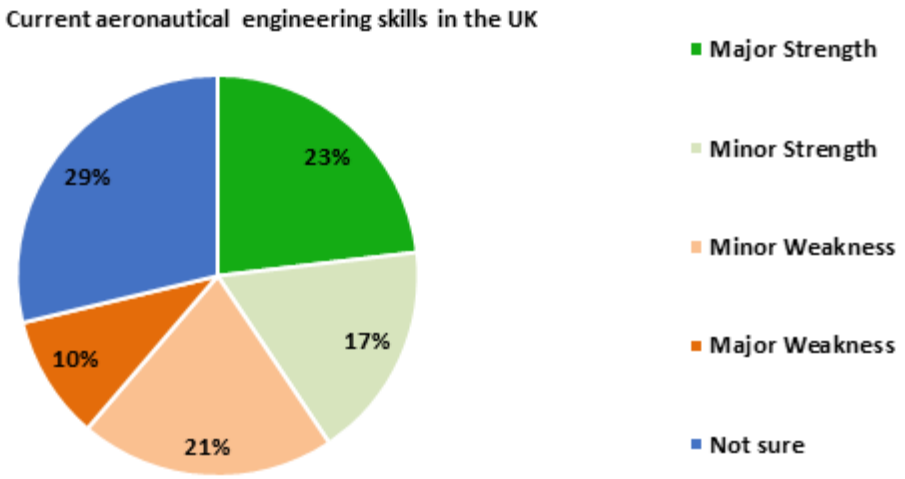
Aeronautical engineering skills

The interviewees agreed that there is a strong engineering tradition in the UK, supported by top-ranking University courses producing highly knowledgeable graduates in the field of aeronautical engineering. It was, however, found that although graduates carry a good foundation into the workplace, it can take a while for these skills to be adapted in a more practical sense. It was found that both apprentices and graduates take longer than desired to adapt to the practical work environment of an aerospace company. Despite this, retention rates of apprentices and graduates appear to be good in general.

The survey respondents lend some support to this argument, although there is not a strong consensus. A total of 40% agree that this is a strength for the supply chain, of which 23% strongly agree, whilst 31% believe aeronautical engineering skills availability to be a weakness of some form. This more mixed view from the wider supply chain may support the view that competition for recruitment with the higher tiers makes it difficult for the lower tiers to secure the top engineering talent they need.

The overall picture across product categories covered by the survey is invariant (as shown in Figure A-33), indicating these thoughts are shared between all product types.

Figure 16 – Results of the survey regarding the current skill level of aeronautical engineers in the UK



Manufacturing engineering skills

The general impression from the interviewees was that engineers in the UK are not regarded with the same degree of prestige as in other countries such as Germany or the USA, particularly in disciplines such as manufacturing engineering.

Interviewees also felt that manufacturing engineering is not widely seen as an attractive career choice. The result was that education in these more specialised engineering fields is seen as inadequate and the talent pool therefore limited and of relatively low quality. This has knock-on effects on innovation in manufacturing processes, as discussed in "Theme 2: Technology and products", below.

Combined with the emphasis in current education on theory, and the absence of "hands-on" learning, this has reduced the availability of manufacturing and manufacturing engineering skills. Due to the current lack of available talent, there is strong competition from the prime contractors and major Tier 1 suppliers and from other industries that require similar skill-sets (e.g. automotive), further amplifying the problem.

A key opportunity outlined by the interviewees was that the industry should collaborate more closely and effectively with universities and schools in order to promote manufacturing in a more positive light, and to encourage young people to pursue a career in manufacturing engineering. The result of this would be to promote a generation of highly-skilled engineers with the ability to improve the efficiency of the manufacturing process, allowing the UK supply chain to become more productive and improve its competitiveness against the rising threat of low-cost labour in emerging markets and high-tech advanced economies.

Despite these strong views from the interviewees, opinion amongst the survey respondents is more mixed, with approximately 47% of all respondents indicating that

manufacturing engineering skills were a strength for the UK supply chain, with a smaller 34% regarding it as a weakness, as shown in Figure 17 below.

This may reflect a lower demand for advanced technology and manufacturing engineering skills in the lower tiers of the aerospace supply chain.

However, within the lower tiers, there is some evidence of a difference in opinion between larger suppliers (e.g. those with over 250 employees) who have a more positive view of manufacturing engineering skills in the UK and smaller ones who have a less positive view (see Figure 18). This may reflect the difficulties that smaller companies face in competing with larger companies for the best available talent.

Figure 17 - Results of the survey, asking for the respondents' thoughts on the current level of manufacturing engineering skills.

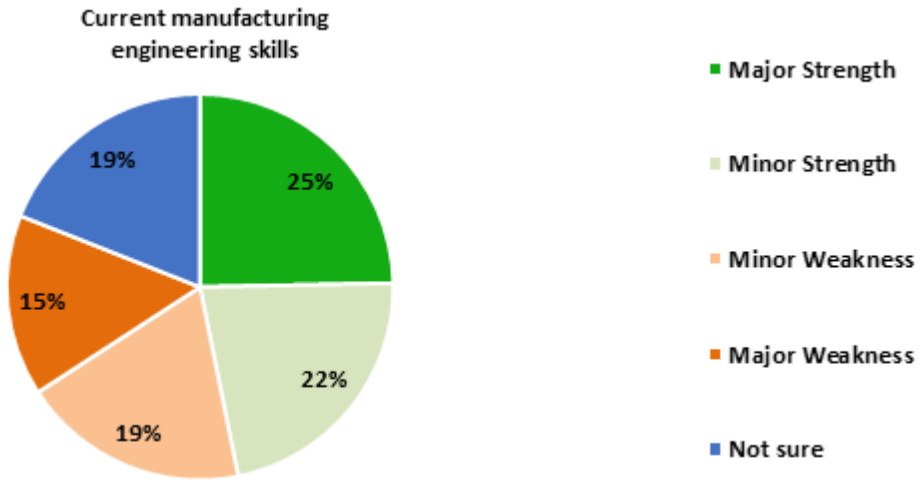
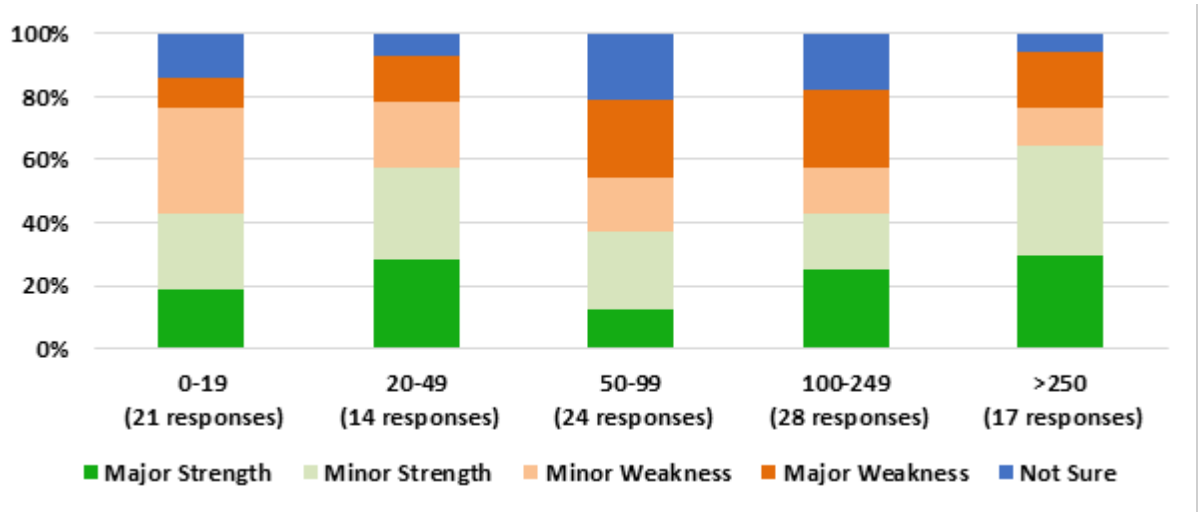


Figure 18 – Survey respondents view of the current level of manufacturing engineering skills, disaggregated by the number of employees



Supply chain and operational management skills

The interviewees indicated that the current civil aerospace supply chain and operational management skills are lacking in the UK, thereby limiting opportunities to differentiate from foreign markets through optimising productivity (particularly low labour cost emerging markets or highly productive advanced economies). This also contributes to the issues highlighted in “Theme 2: Technology and products”, on the lack of innovation in manufacturing. The widely suggested reason for this is due to the perception that supply chain and operational management careers are seen as unattractive compared to other pursuits and that as a result the availability of training in these areas through education is limited. As with manufacturing engineering, however, the survey respondents show a difference of opinion with the interviewees, with a larger number of respondents (46% and 45%) viewing this area as a strength than as a weakness (33% and 38%) for leadership and management skills, and supply chain management skills respectively.

Figure 19 - Results of the survey for current leadership and management skills within the UK supply chain

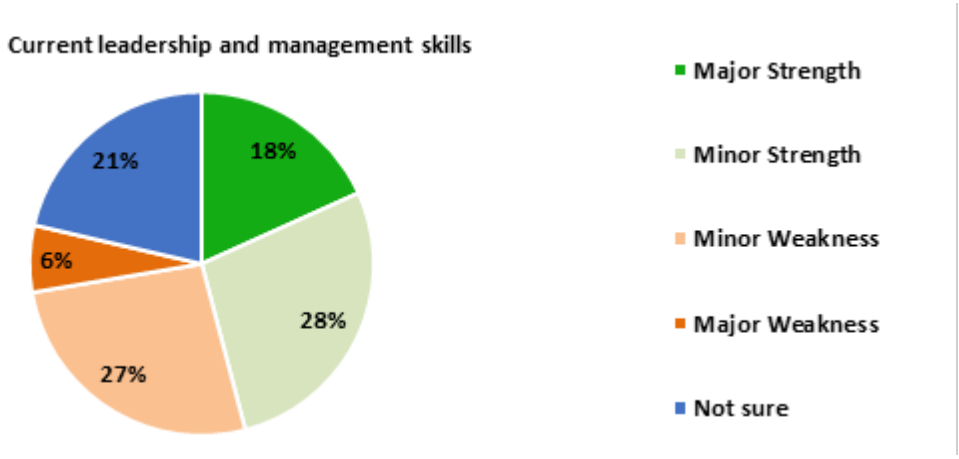
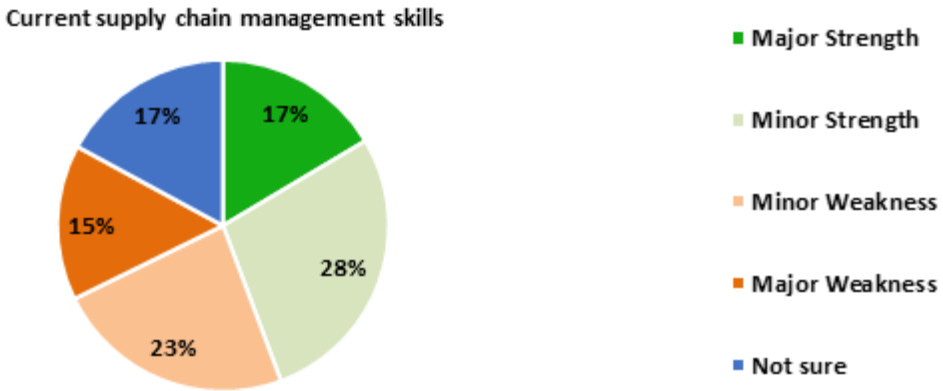


Figure 20 - Results of the survey for current supply chain management skills within the UK supply chain



When these results are disaggregated by the number of full-time employees across sites in the UK, the results reveal a trend, as graphically shown in Figure 21. There is an increase in the rate of response that supply chain management skills are a major strength for the UK supply chain with decreasing company size. For the lowest bands, 0-19 and 20-49 employees, 23% and 40% of respondents indicated that supply chain management was a major strength of the UK supply chain, which decreases to 11% for companies with over 250 employees. This trend suggests that the lower tiers are more optimistic than the primes and larger suppliers about their ability to manage their supply chains efficiently, potentially highlighting a disconnect between what the higher tiers view as necessary to achieve the continuous productivity improvements that they require from their supply chain and what the lower tiers believe is necessary.

Figure 21 - Results of the online survey for the current level of supply chain management within the UK supply chain disaggregated by the number of full-time employees across all UK sites as a metric for company size

Education and training in new technology areas

The interviewees indicated that although traditional aeronautical skills are highly regarded, education and training in relevant new technology areas, e.g. composites, additive manufacturing, or security algorithms, have not kept pace with technology. As a result, there is a perceived lack of talent in the UK amongst emerging disciplines which may be key to maintaining the UK's position in the global civil aerospace supply chain. Again however, this is not strongly reflected by the survey respondents. There is a fairly even split between those who feel that this expertise is a strength or a weakness, and the majority of responses indicate either a minor weakness or strength. These results can be further disaggregated by material types used.

For those companies that principally use metals for their products, the views on current skills expertise appears to be slightly more pessimistic when compared to companies who have composite capabilities. About 52% of respondents from companies that use composites indicate that this is a strength for the UK supply chain in some form, perhaps indicating that those companies who have invested in new materials feel more comfortable with the advent of new technology and with the availability of talent in these areas.

Figure 22 - Results of the survey regarding the current skills expertise in new technological fields such as composites

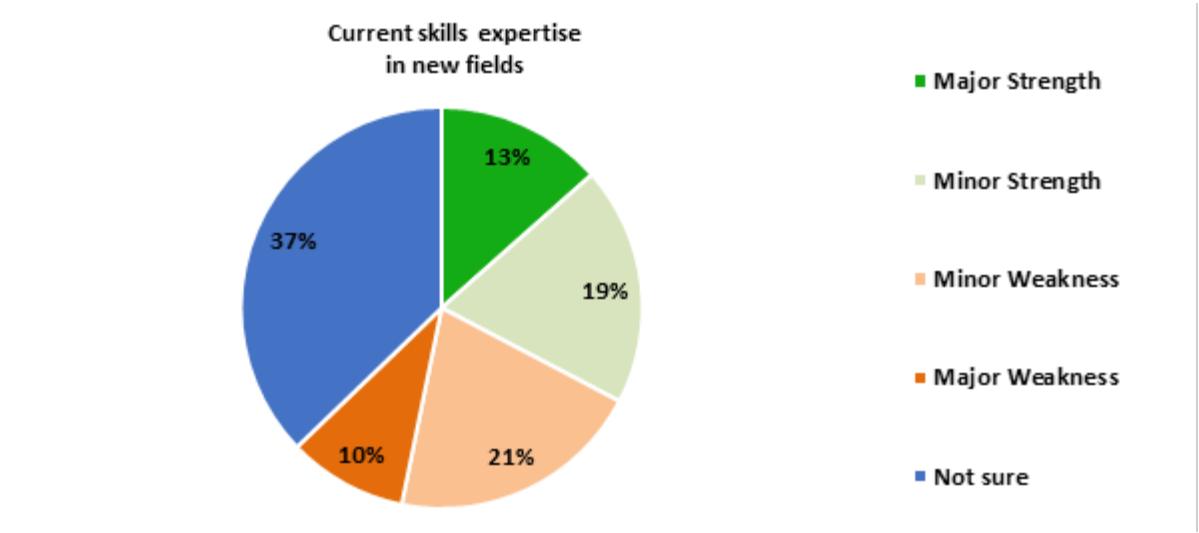
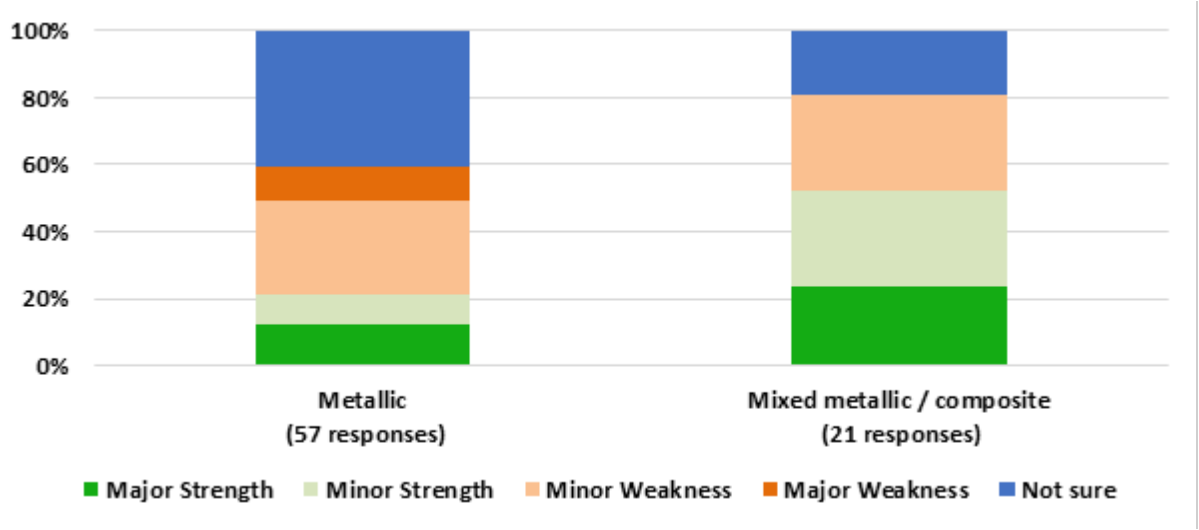


Figure 23 - The results of the online survey for current skills expertise in new fields, disaggregated by material type.



Workforce in low cost economies

The interviewees indicated a significant threat from increasingly skilled and lower cost workforces in emerging markets such as the Far East and Middle East. Some interviewees considered the sourcing of parts in low-cost economies as essential in maintaining cost competitiveness, whilst others were more reluctant to outsource due to concerns over product quality or the time and effort needed to manage distant suppliers, particularly if major problems arise. In general, however, it was agreed that for high-labour, low-complexity products, emerging markets with a low-cost workforce were becoming increasingly attractive, and that a combination of up-skilling the workforce and embracing new manufacturing technologies and supply chain processes are required to improve productivity in the UK as the key tool to discourage offshoring.

The full list of points under Theme 1 which were highlighted by prime contractors and key suppliers in their interviews are summarised in Table A-3.

Theme 2: Technology and products

Despite its strong reputation for innovation and aeronautical engineering, many interviewees had a less positive view of the UK aerospace supply chain in terms of its technological prowess, although a number of specific opportunities were highlighted for potential growth in the future.

Gaps in UK capabilities

Interviewees highlighted a number of technological areas where they felt that UK capability needed to improve in order to compete globally. Areas identified that the UK is either missing, or where capability is not competitive enough are listed in Table 1.

Table 1 - Areas identified by Prime contractors and key suppliers as areas in which present UK capability is either absent, could be developed or is not competitive enough

Systems and Equipment	Propulsion	Processes and Materials	Aero-structures	Other
• Actuation • Air systems • Antennae • Electrical Power • Printed Circuit Board Assembly • Transmission systems	• Fuel Systems	• Carbon fibre • Composite manufacture • Dressings • Large forging and machining • Plating • Post-machining • Specialist resins (e.g. multi-functional epoxy) • Stress manufacture • Stretch forming • Surface treatment • Titanium machining	• Bearings • Rotary wing supplier	• Automated test systems • Interiors • Test equipment • Tooling (e.g. jig fixtures)

One particular area for concern highlighted by interviewees is a lack of approved surface treatment houses in the UK with the correct aerospace accreditation. As a result, work throughput exceeds the capacity of these houses, and this often acts as a bottleneck to the entire supply chain. However, since gaining the appropriate aerospace accreditation for surface treatment processes, and gaining approval status from customers is a time-consuming process, competition from new entrants is slow to emerge, meaning the treatment houses have little incentive to streamline their processes.

In addition, it was noted that REACH legislation has amplified this situation. Since surface treatment houses use chemicals that need to be monitored, any new process must be shown to satisfy the legislation, further slowing down the emergence of new domestic surface treatment house competition.

Surface treatment processes are often kept on-shore due to the large costs and inconvenience of shipping products to a more distant supplier. Treatment houses in areas in which environmental regulations are not so stringent will be able to accommodate growth with more flexibility. Therefore, if the capacity of surface treatment houses does not improve then this is a threat not only to domestic treatment houses, but also to the cost competitiveness of suppliers who are reliant upon using these processes locally.

Similarly, survey respondents were asked whether they could source all the products and materials from the UK that they needed. In response to this question, 13% indicated that there were products that they would like to source from the UK but at this point in time can't. The results of these capability gaps are summarised in the Table 2 below.

Table 2 - A summary of products that suppliers are unable to source in the UK

Systems and Equipment	Propulsion	Processes and Materials	Aero-structures
• Adaptors • Catalytic converters	• N/A	• Carbon fibre and braids • Castings • Dyes • Material spray powder • Thermoset moulding materials • Titanium machining • Vacuum melted Steel and Aluminium • Wire (specialist) • Zinc-Nickel treatments	• Extruded hose valves

There are a few areas of overlap between the survey respondents and the interviewees, particularly in the field of processes and materials. In particular, surface treatment, titanium machining, specialist wire and carbon fibre were highlighted as lacking capability in the UK supply chain. By contrast, there are almost no areas in which the UK is seen as lacking capability for propulsion and aero-structure parts. This is perhaps a reflection of the dominance of these two markets as described in "Primes views".

Technology innovation and productisation

The UK has a tradition of advancing technology and innovation in product design. The interviewees expressed the view that strong Government support for early-stage product development, which may be in the form of innovation funding, initiatives such as the ATI, or Research Council grants, continues to promote innovation within the supply chain.

Some questions in the online survey referred to innovation in the general supply chain, as well as the UK's network of Catapult centres. The results indicate that the survey respondents agree that earlier stage innovation within the supply chain is strong, since 60% of all responses expressed positive views to questions asking about innovation in product design (Figure 24), and 50% expressed positive views about the availability of Catapult centres to further this research (Figure 25). There was little variation by company size (Figure 26). As discussed in "Theme 4: Government engagement", the survey also corroborates the finding that support for early-stage research and product development is a strength of the UK aerospace supply chain.

However, the ability of the UK aerospace supply chain to develop these innovations into customer-ready products with strong value propositions that enable them to differentiate themselves globally, is limited. This may in part be due to the perceived lack of available late-stage product development support identified in "Theme 4: Government engagement" but also in part to skills and capability gaps identified amongst UK suppliers.

Overall it was felt that innovative products that reach the marketplace for the higher tiers are developed almost exclusively by the upper tiers of the supply chain, where research funds are not as dependent upon external sources and companies have sufficient capital to cover the costs of the later, more capital-intensive stages of product development and manufacturing investment. In order to encourage innovation from the lower tiers, interviewees expressed a need for SMEs to secure investment in conjunction with Tier 1 suppliers (and with the aid of Government where necessary) to develop certified products that offer a step change in value generation for customers, and counter the perception of a lack of innovation from UK SMEs.

Figure 24 - Results of the online survey for the innovation in product design within the UK supply chain.

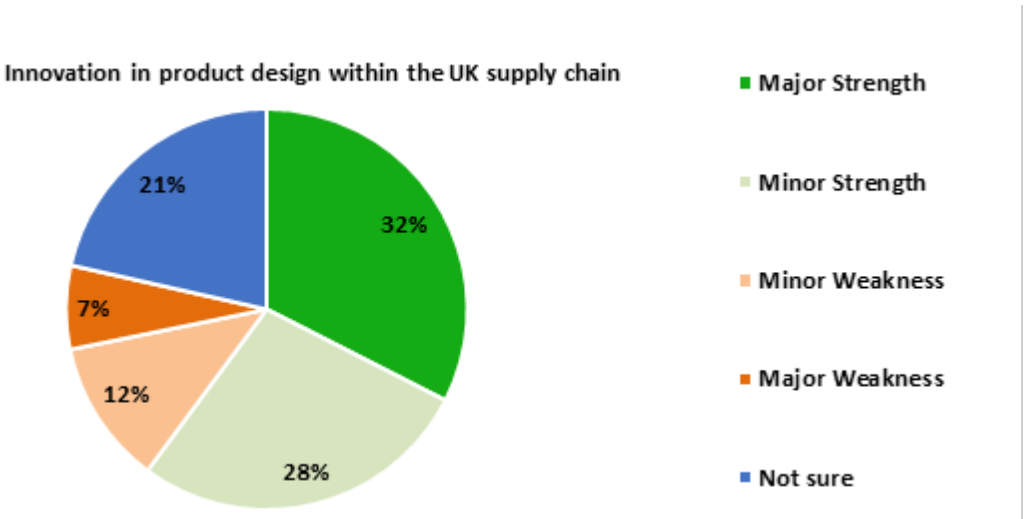


Figure 25 - Results of the online survey for the availability of advanced technology and development facilities (e.g. the Catapult centres)

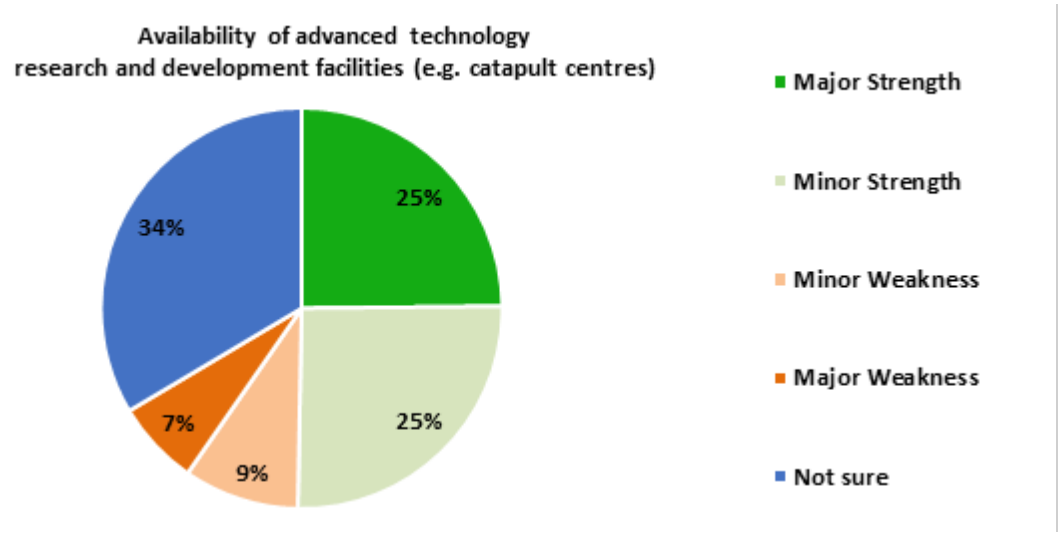
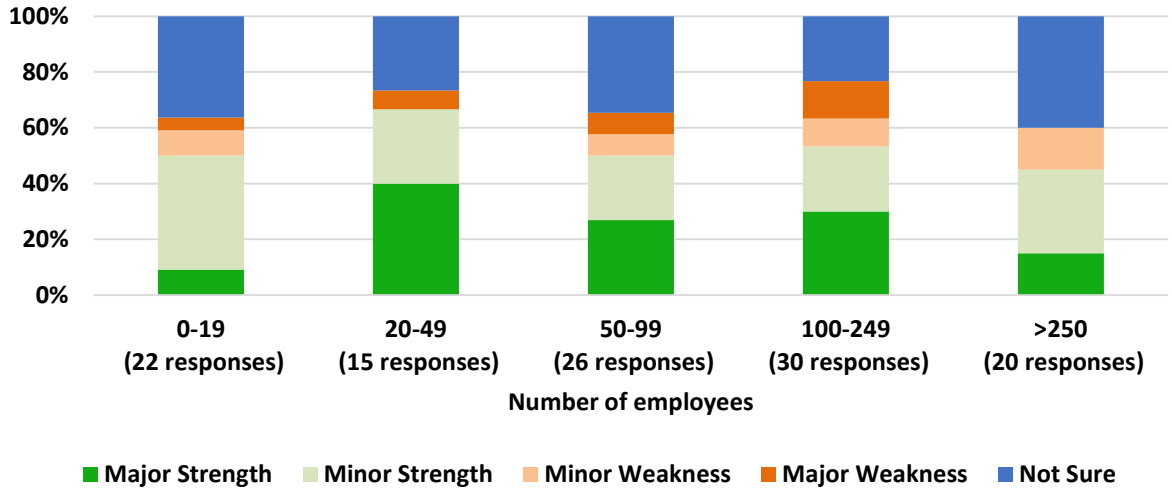


Figure 26 – Results of the online survey for the availability of advanced technology research and development facilities, disaggregated by the number of employees as a metric for company size

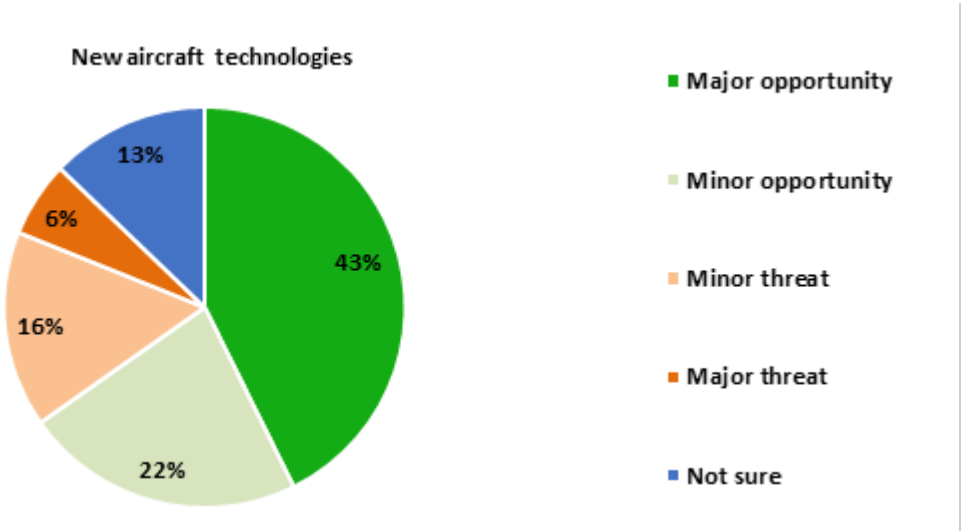


New aircraft technologies

The interviewees expressed the view that developing capabilities aligned with new aircraft technologies is a significant opportunity for the UK supply chain. The parts that will be used on future aircraft programmes are likely to be substantially different, including, for example, the replacement of hydraulic systems through electrification, increased usage of lightweight composite material technologies and the introduction of advanced telecommunications technologies. Developing these capabilities domestically would make the UK more attractive for securing workshare on future aircraft programmes.

The survey respondents indicate an agreement with the interviewees, with 65% of respondents indicating that this an opportunity for the supply chain, of which 43% felt it was a major opportunity, as shown in Figure 27.

Figure 27 - Results of the survey regarding the views of the respondents of whether new aircraft technologies present a threat or an opportunity.



When this is broken down further by the product stream(s) in which each company operates, there is no significant trend.

Manufacturing processes and technologies

The interviewees felt that current manufacturing processes amongst suppliers do not make use of the latest manufacturing technologies, automation or supply chain processes to achieve high levels of productivity. Foreign markets (e.g. Japan, Germany, USA) were seen as leading the way in developing lean, efficient and state-of-the-art manufacturing techniques and were therefore viewed as better able to compete on a global scale through achieving higher productivity levels.

This was often linked back to the lack of educational focus and skills in manufacturing engineering and supply chain management (as highlighted in “Theme 1: Labour force”), as well as a lack of support in capital investment for productisation and manufacturing technologies (as highlighted in “Theme 4: Government engagement”). This lack of innovation also exposes the UK supply chain to threats from low labour-cost emerging markets, which are aggressively investing in supporting new manufacturing capability. For example, some foreign governments are known to have partnered major Tier 1 suppliers in joint ventures with domestic companies, to aid the development of a diverse range of capabilities within an emerging market and allow for their home market to become competitive on a global scale. Other governments have been known to align themselves to the needs of new aircraft programmes, in an effort to secure a stake in these programmes to benefit their domestic supply chains.

Interviewees highlighted how they look to constantly evolve their manufacturing processes, actively setting aside funds to improve efficiency on a continuous basis in order to support their internal drive for continuous improvements in cost competitiveness. They were keen

to see continuous improvement in manufacturing efficiency amongst their UK suppliers to support this ongoing efficiency drive and counter the twin threats from low labour costs in emerging markets and competition from high-efficiency modern economies. One sector highlighted by interviewees as being a model for implementing lean manufacturing processes and achieving continuous improvement was that of the automotive industry, and it was suggested that aerospace production lines could learn lessons from this sector about how to make manufacturing and supply chain processes more efficient.

Whilst there was agreement that new manufacturing technologies such as additive manufacture or automation, represent a significant opportunity for the supply chain amongst survey respondents (see Figure 29), the results of the survey tended to disagree with many of the interviewees views discussed above. As Figure 28 demonstrates, 50% of all respondents believe that the use of the latest engineering and supply chain processes is a strength of the UK supply chain at present, with only 25% identifying it as a weakness, as shown in Figure 28. This disparity in views supports the disconnect in opinions between the lower and higher tiers of the aerospace supply chain, identified in “Theme 1: Labour force”, with regards to their ability to succeed in the global market through using the most advanced manufacturing, supply chain and support function processes.

Figure 28 - Results of the online survey for the use of the latest manufacturing engineering and supply chain processes

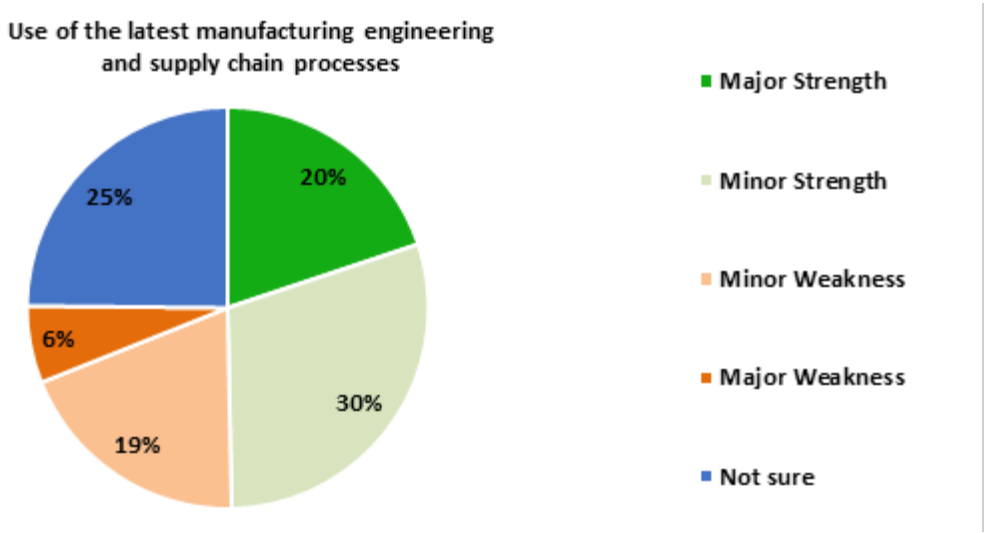


Figure 29 - Results of the online survey for the use of the latest manufacturing engineering and supply chain processes, disaggregated by the number of full-time employees across all UK sites as a metric for company size

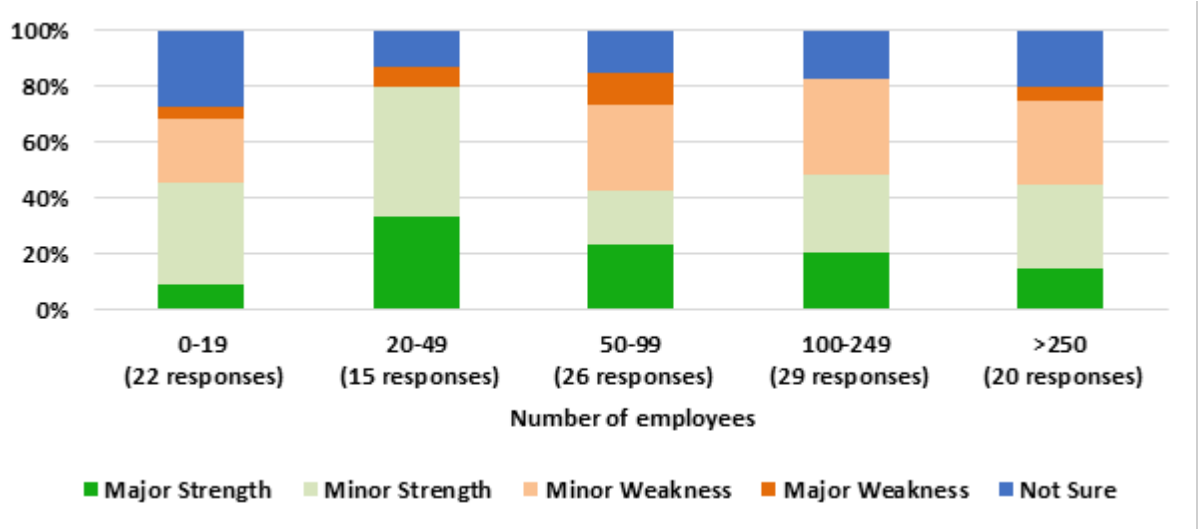
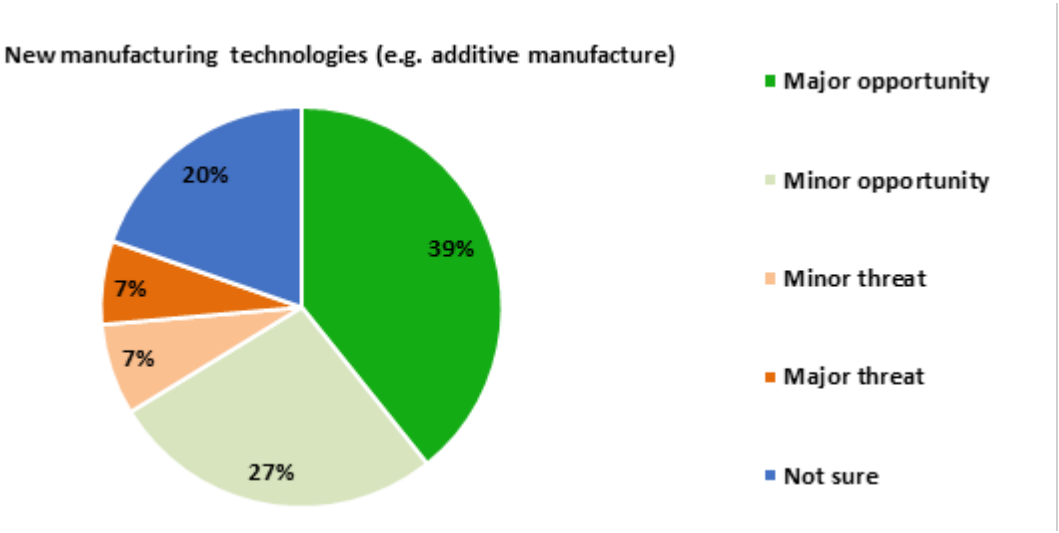


Figure 30 - Results of the online survey for the opportunity or threat posed by new manufacturing technologies to the UK supply chain



Future aircraft programmes

New aircraft programmes are likely to feature substantially different products, spurred in part by competitive dynamics, cost demands of airlines and the need to reduce the environmental impact of aircraft. The survey respondents indicated that the UK aerospace supply chain views developing capability in new aircraft technologies and for future aircraft programmes as very strong opportunities, with79% of respondents seeing future aircraft programmes as opportunities, as shown in Figure 31. However, interviewees expressed that whilst they recognise that this is a major opportunity for the supply chain, they are concerned that the UK supply chain is not currently well positioned to benefit from a major stake in any new aircraft programme.

They felt that major investments are required by UK-based Tier 1s and prime contractors, with the support of Government, into upgrading manufacturing capabilities. Additionally, they felt that some smaller suppliers lack the capabilities to access these opportunities through export markets, for many of the reasons highlighted above. These results reinforce the view that there is a potential disconnect between the views of the interviewees and the lower tiers of the supply chain with regards to the opportunities presented by new aircraft programmes in particular.

Figure 31 - Results of the survey for the qualitative question for future aircraft programmes

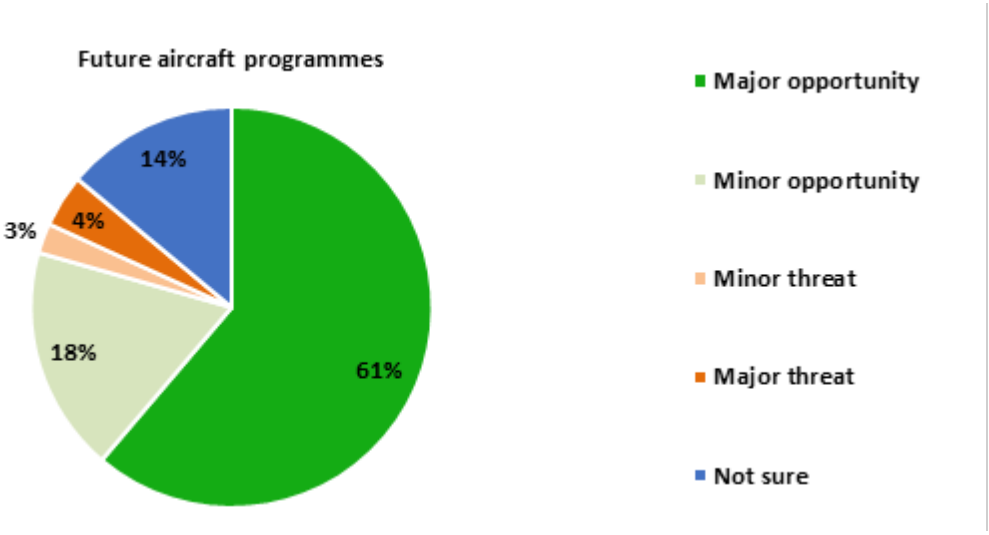
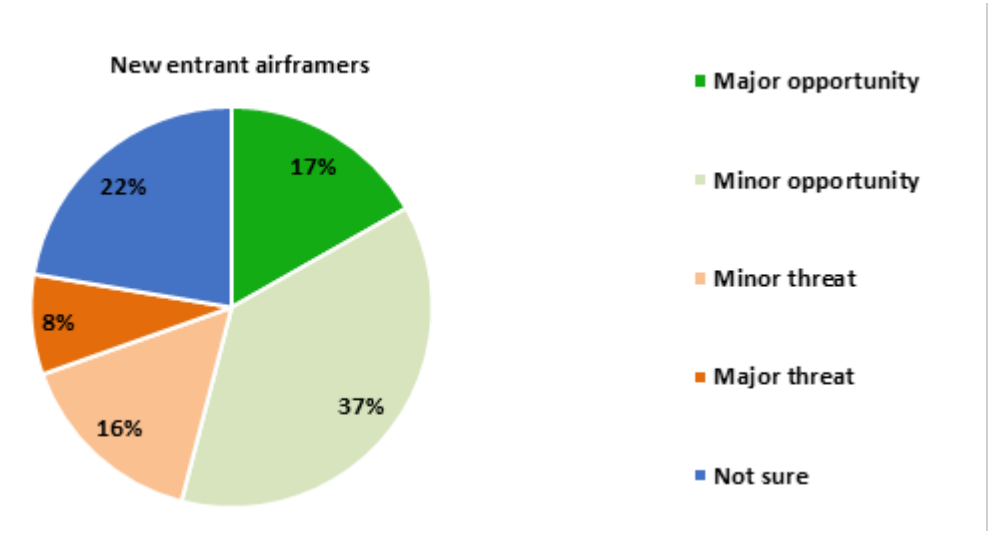


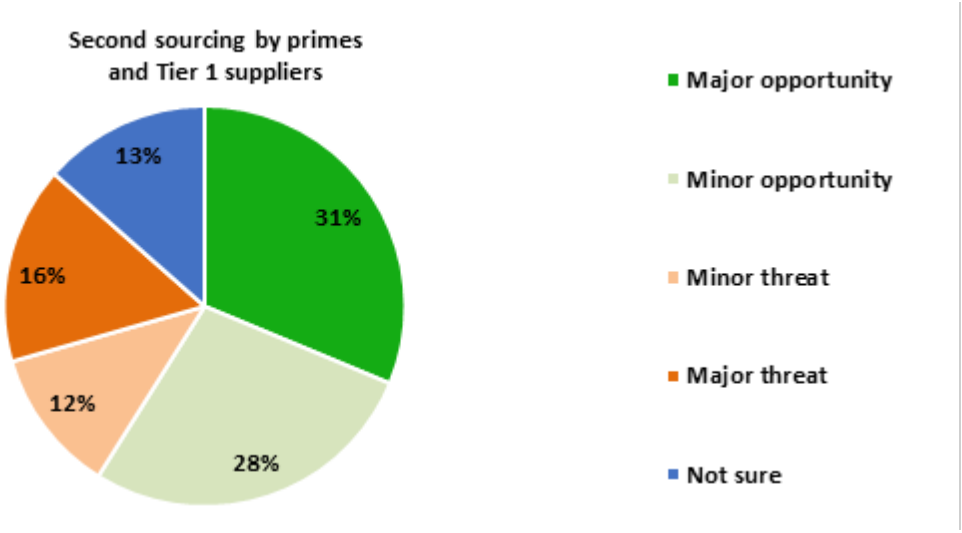
Figure 32 - Results of the online survey for new entrant aircrafts (e.g. typically non-Western companies).



Discussions around dual sourcing garnered mixed responses from the interviewees, with general agreement that if a company is well positioned to cope with increasing workflow as demand ramps up, then there is no need to consider dual sourcing as a threat. However,

in the case where capacity requirements cannot be easily met, then this will provide a threat to the supplier. The survey seems to reflect these sentiments: 59% of respondents felt that dual sourcing presents an opportunity to the supply chain, with 31% indicating this to be a major opportunity for the supply chain, as shown in Figure 33. Of the remaining respondents, 28% considered dual sourcing to be a threat of some kind. The survey respondents thereby indicate an appreciation of the opportunities and threats that dual sourcing poses, but are generally confident that the supply chain has the capacity to ensure that dual sourcing is an opportunity. When broken down by product type, there is no significant variation between product types.

Figure 33 - Results of the online survey for the opportunity or threat that dual sourcing by prime contactors and Tier 1 suppliers poses for the UK supply chain



When disaggregated by the number of employees as a metric for company size however, there is a general increase in the proportion of response that indicate that dual sourcing is a threat to the UK's supply chain, from 23% for the smallest companies (0-19 employees), to 45% for the largest companies covered by the survey, as shown in Figure 34. This general trend supports the view that there is a disconnect between the lower and higher tiers of the supply chain, with many larger companies having a more global view of the supply chain and of the growing threats from increasing production of high quality products from lower labour cost emerging markets, whilst smaller companies may be less aware of the threats that the increasing globalisation of the supply chain poses to the UK supply chain.

Figure 34 - Results of the online survey for dual sourcing disaggregated by the number of employees for a company across all UK sites, as a metric for company size.

The full list of points under Theme 2 which were highlighted by the interviewees are summarised in Table A-4

Theme 3: Supply chain interactions

Whilst UK-based prime and other suppliers who were interviewed may have an interest in supporting their local supply chain, this was often not seen as an area of primary concern when selecting suppliers. In fact, many interviewees had a relatively poor view of UK suppliers' ability to meet all of their needs in an increasingly global and competitive supply chain.

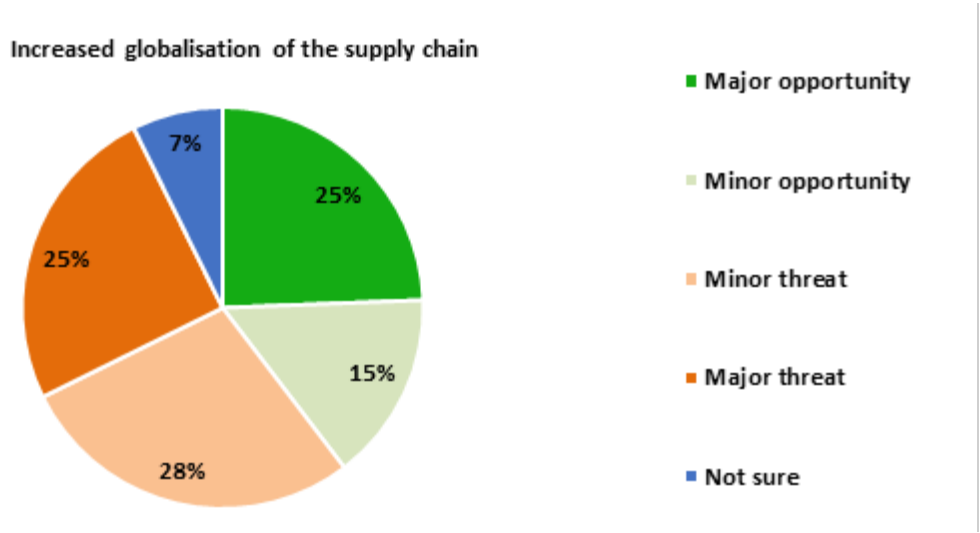
Global competitiveness of the UK supply chain

Whilst there is some advantage from dealing with local suppliers, many prime contractors and key suppliers expressed an indifference as to where their products are sourced. Provided a product meets all the quality, cost and flexibility of supply targets desired, proximity was not considered a major factor in sourcing decisions. The main exceptions to this rule were for processes, such as processing houses, where transportation of materials offshore can be a costly process in terms of time and money.

With the quality of off-shore markets improving rapidly, there is an ever increasing threat of UK suppliers losing work abroad, as illustrated by the declining market share discussed in the Structure and Value of the Supply Chain section above. The interviewees felt that many supply chain companies in the UK lack the managerial, financial and operational expertise required to deliver products on time and on budget, with many reporting an inability to supply on time and poor flexibility in meeting the varying demands necessitated by today's global supply chain. This is further compounded by the fact that many SMEs lack the support functions (e.g. marketing and sales teams and strategy) that would enable them to effectively 'court' prime contractors, convince them of their ability to deliver and meet demand growth and therefore compete in an increasingly global market place. As a result, globalisation and supply chain consolidation was seen by prime contractors and key suppliers as a threat to the UK supply chain.

The results of the survey illustrate some recognition of the threat from globalisation amongst respondents, with slightly more companies considering globalisation a threat (53%) than an opportunity (40%), as shown in Figure 35.

Figure 35 - Results of the survey for whether the increased globalisation of the supply chain poses a threat or an opportunity for the supply chain



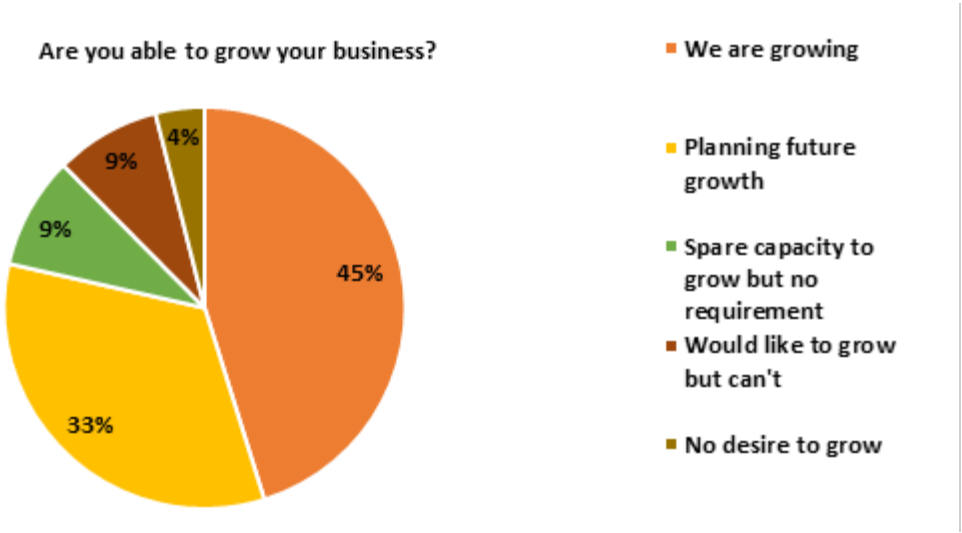
Growth expectations amongst the UK supply chain

Despite the mixed views in relation to globalisation, survey respondents stated a strong desire to grow, or to continue growing, as demonstrated in Figure 36. 45% of survey respondents indicated that at present, their company is already experiencing growth of some kind and a further 33% are looking to grow, most likely through increasing capacity for their processes. Only 22% indicated that they feel that growth in the future is unlikely, 9% of which already have the capacity to deal with growth should it be required. Overall, the survey respondents are strongly optimistic for the future, and the position of the UK in the global market.

This is in direct contrast to the view of many interviewees, that many suppliers are either unwilling to grow, or lack the continuous improvement programmes necessary to effectively manage growth. The interviewees also expressed the view that whilst improvement programmes, such as SC21, are highly beneficial for improving competitiveness, they are only a first step and follow-on programmes are required to achieve global excellence. Additionally, a lack of business acumen, supply chain management, support functions and sales and marketing strategy were identified as contributing factors to the apparent limited ability to grow within the lower tiers.

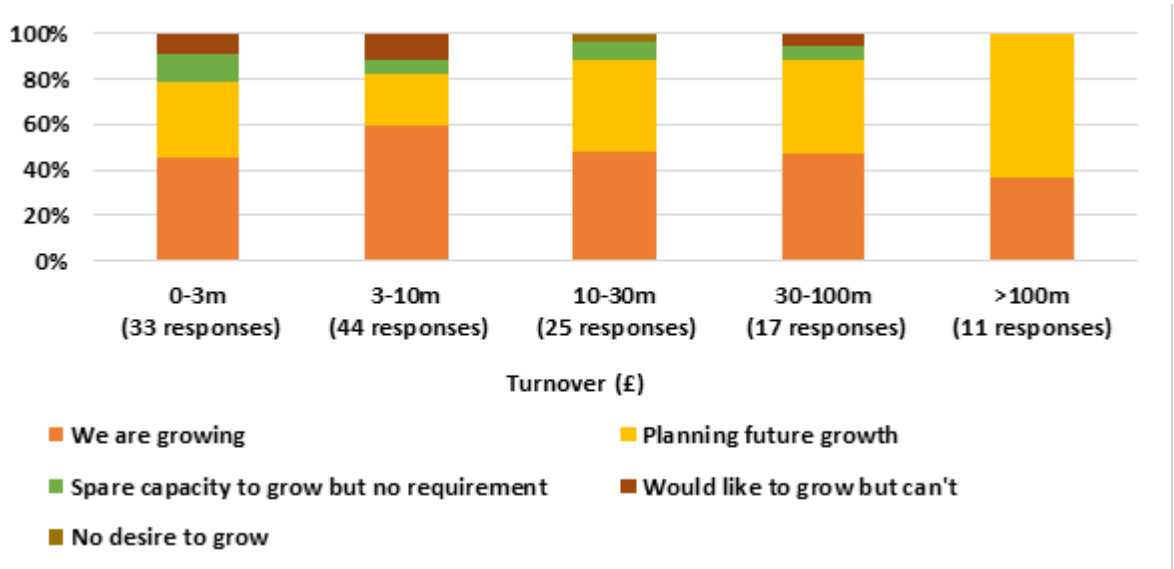
Despite over 78% of survey respondents stating that they are either growing already or planning to grow, only 53% of the respondents indicated that they use at least one form of improvement programme for efficiency. This supports the interviewees' views on the lack of appreciation of the need for such programmes and it is likely that these apparent deficiencies are contributing to the falling UK market share identified earlier. The marked difference between willingness to grow and engagement with improvement programmes supports the view expressed earlier that there is a disconnect between what the upper and lower tiers of the aerospace supply chain believe is necessary to achieve continued growth and success in the global supply chain.

Figure 36 - Results of the online survey for the ability of respondents to grow in the current UK supply chain.



When disaggregated by company turnover as in Figure 37, it can be seen that around half of survey respondents from all company sizes are currently growing. However, c. 20% of survey respondents for the small-medium companies (£0-10m turnover) indicated that future growth is unlikely, with c. 10% of medium-larger companies (£10-100m turnover) expecting no growth, but all of the largest companies expecting growth either today or in the future. This result reflects the view of the interviewees that the lower tiers of the supply chain are less well equipped to access growth linked to the globalisation of the aerospace supply chain.

Figure 37 - Results of the online survey for the ability of survey respondents to grow, disaggregated by company turnover



Interaction between upper- and lower-tiers

When asked about the barriers which may be preventing growth or making it harder to achieve, the two leading reasons stated by survey respondents were the length of

contracts imposed by larger companies in the supply chain and low availability of skills and training, as shown in Figure 38:

- Contract conditions between the upper and lower supply chain tiers are seen by survey respondents as a major weakness to the success of the supply chain, as illustrated in Figure 39 where 71% of survey respondents view procurement behaviour of major companies as a weakness of the supply chain. Interviewees recognised this issue and that small companies are concerned about having to make investments in order to qualify for long-term aircraft programmes, but supported only by limited duration contracts with no assurance of achieving a long-term payback on their initial investment - thereby reducing their willingness and flexibility to respond to customer demands.
- The lack of skills training are also seen as a key barrier to growth, with competition from the upper tiers highlighted as a barrier to recruiting the best talent. Additionally many of the survey respondents recognised the lack of manufacturing engineering, supply chain management, procurement and leadership skills highlighted by the interviewees, and discussed extensively in “Education and training in new technology areas”. Without the skills to evolve manufacturing processes through continuous improvement, and without the coherent sales and marketing strategy that supply chain and procurement teams provide, smaller supply chain companies are unable to grow.

The survey responses to this question generally support the apparent disconnect between the views of the upper and lower tiers of the UK aerospace supply chain. The results of the survey indicate that the main barriers to growth for the UK aerospace supply chain are the length of contracts with prime contractors and the availability of skills and training. Whilst the interviewees did recognise the impact of their complex procurement processes, they did not see them changing in the near term and instead identified the various issues outlined in the sections above for limiting growth within the lower tiers.

Figure 38 - The current barriers to growth from the online survey

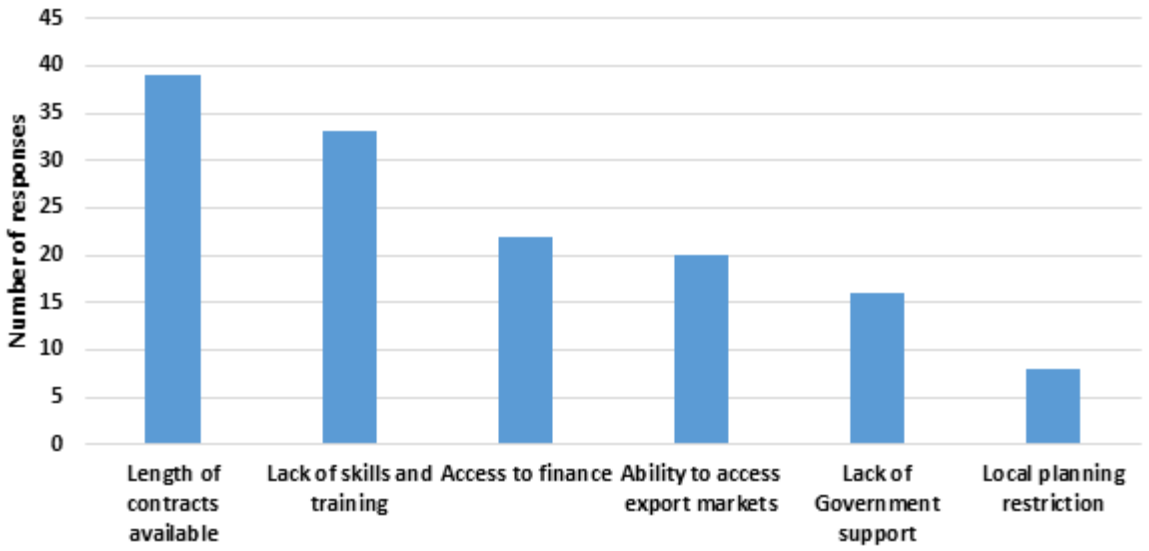
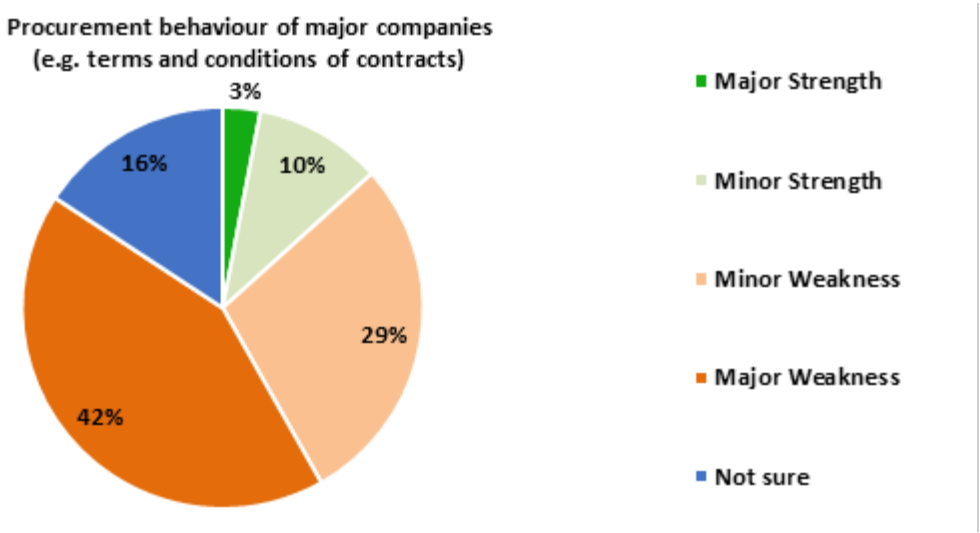


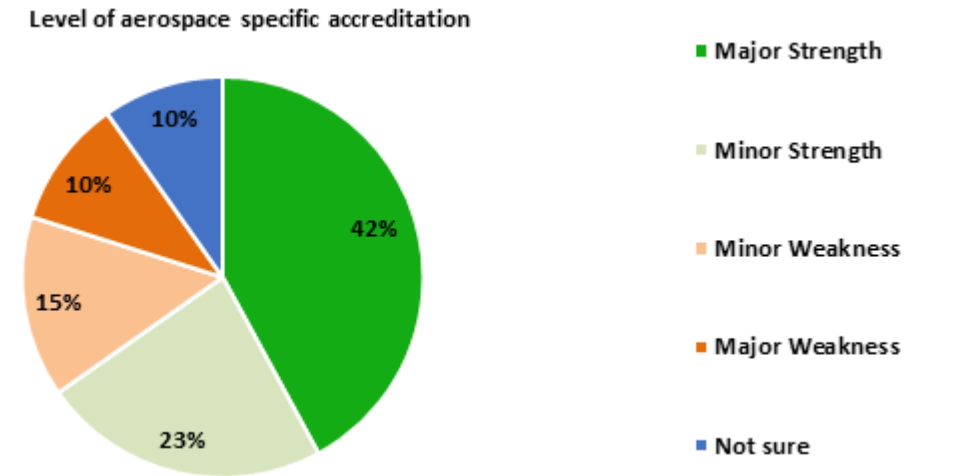
Figure 39 - Results of the online survey for the procurement behaviour of the major companies



Accreditation and achieving approved status from customers

According to the interviewees, official supplier accreditation is an essential pre-requisite for suppliers of many products that they wish to source. In the aerospace industry, quality, reliability, and safety are critical values and as a result a supplier must meet stringent requirements in order to have access to major clients. Funding is not widely available for gaining the appropriate certification, and smaller suppliers who have less strong cash flow positions can struggle to fund the approvals process. The survey respondents were asked whether the current level of aerospace-specific accreditation is a strength or weakness for the supply chain. The results of this indicate that suppliers consider the current level a strength, with 65% responding positively to the question, 42% of which see accreditation as a major strength. This suggests that the supply chain generally feels that the accreditation within the UK serves its purpose of maintaining the quality of product that the UK is traditionally known for.

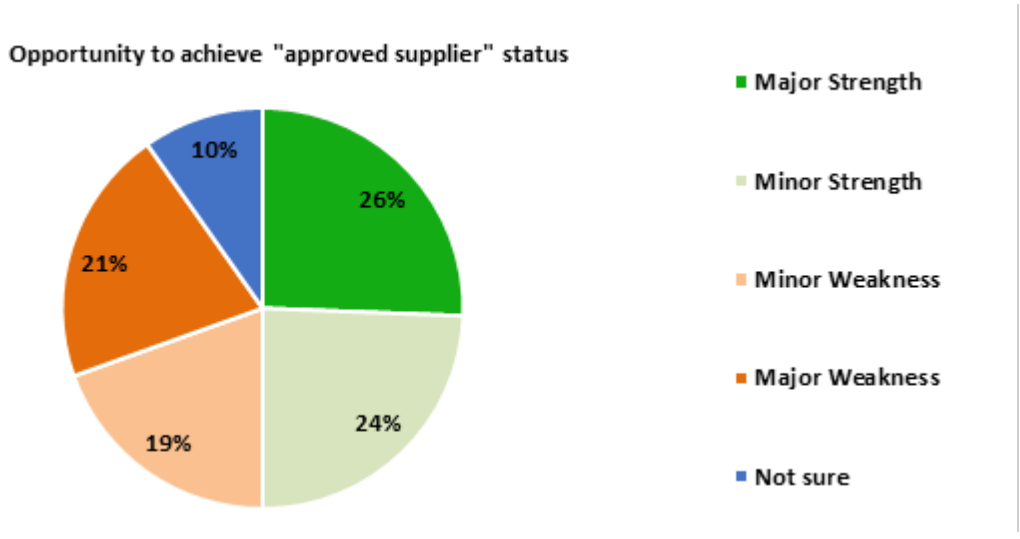
Figure 40 - Results of the online survey for the level of aerospace specific accreditation



In addition to official certification requirements, prime contractors generally have their own approved supplier lists which dictate which companies they can source from.

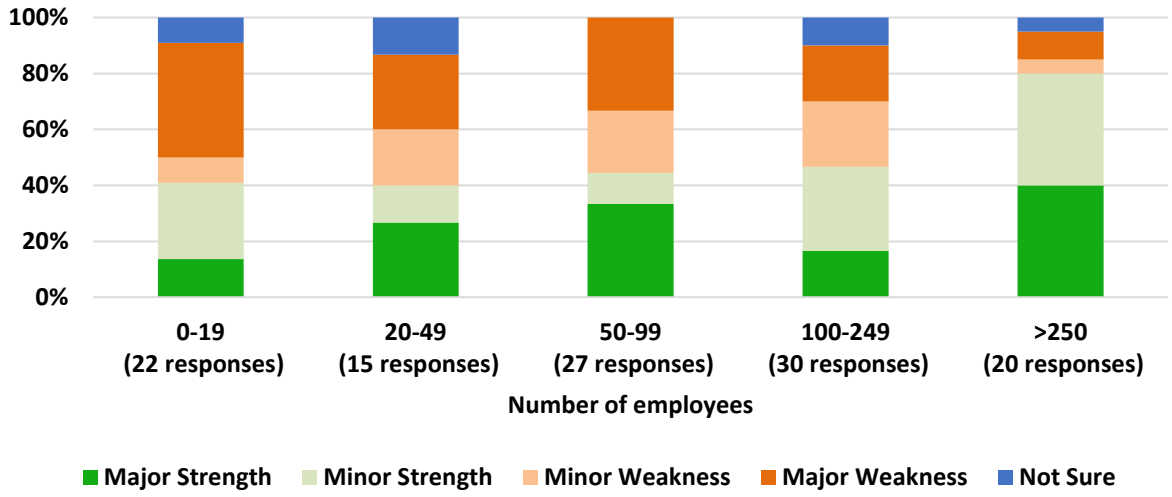
By the prime contractors' own admission, gaining approved status is a challenging, costly and time-consuming process, not only for achieving initial approval, but also for the regular audits that are required thereafter. Issues that smaller companies face in achieving approved supplier status with their customers include finding an opportunity to present their product, and developing a clear marketing strategy to help promote their company with the customer. Further to this, major companies are now seeking to rationalise their supply chains by looking to companies with more extensive in-house capabilities. By reducing the number of suppliers, supply chain management is heavily simplified, and, as a result, major Tier 1 suppliers are now seeking to develop capability in-house either through in-house research, partnerships with smaller companies, or through vertical integration. This compounds the issue of reaching approval status from prime contractors, since the number of companies in a particular supply chain is likely to reduce over the coming years. For those companies that have already achieved approved supplier status, however, workflow is good, since the filtering of suppliers reduces domestic and international competition for work from the major Tier 1 companies. Overall the feeling of survey respondents is somewhat mixed in relation to the opportunities to achieve approved supplier status, with c. 50% suggesting it is a strength and 40% a weakness of the supply chain, as shown in Figure 41.

Figure 41 – Results of the online survey for the opportunity to achieve approved supplier status.



When disaggregated by the company size, the survey results indicate a clear trend whereby smaller companies view the opportunities to achieve approved supplier status amongst the major end-customers fairly negatively, whilst larger companies view these opportunities much more favourably, as shown in Figure 42. This supports the view that smaller companies which do not have the resources to run through the onerous approvals and auditing processes may find it more difficult to access major end-customers and may need to partner with larger Tier 1 or other suppliers to access these customers.

Figure 42 – Results of the online survey for the opportunity to achieve approved supplier status, disaggregated by the number of employees as a metric for company size



Certain standardised programmes such as SC21 (21st Century Supply Chains) are seen as very beneficial, often leading to significant improvements in supplier performance compared to those who have not participated in any efficiency programmes. However they do not replace the prime contractor-specific approvals and auditing that is required of each supplier, but instead can act as an initial filter. The survey respondents reflect this positivity, with nearly 60% of suppliers indicating that programmes such as SC21 are a strength of the supply chain, as shown in Figure 43. The large “not sure” response rate may be due to some companies not being aware of such programmes, thereby illustrating the need for continued promotion of such programmes and their benefits. This lack of awareness of the benefits of such programmes is supported by the fact that only 53% of survey respondents use any sort of programme to improve operational efficiency, as shown in Figure 44.

One key message from the interviewees was that the SC21 programme should be seen as a minimum standard or a first step towards further continuous improvement programmes. Whilst highly beneficial in itself, the programme isn’t seen as going far enough in helping companies to achieve excellence and global competitiveness. A follow-on programme was strongly recommended, to support suppliers in ensuring that they continue to improve efficiency through leaning manufacture, supply chain management and overall streamlining of processes to reach these higher, globally competitive standards.

Figure 43 - Results of the survey for the improvement programmes open to the UK supply chain, such as SC21.

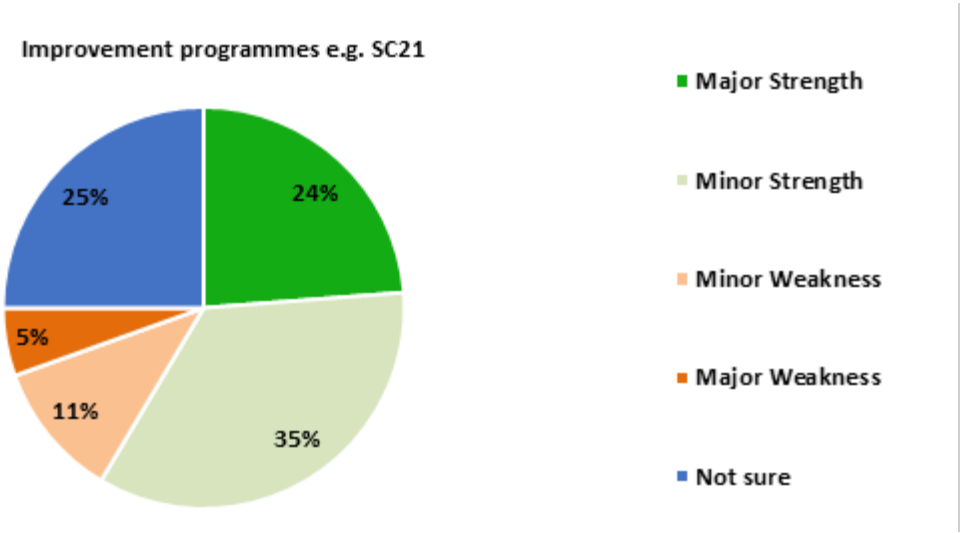
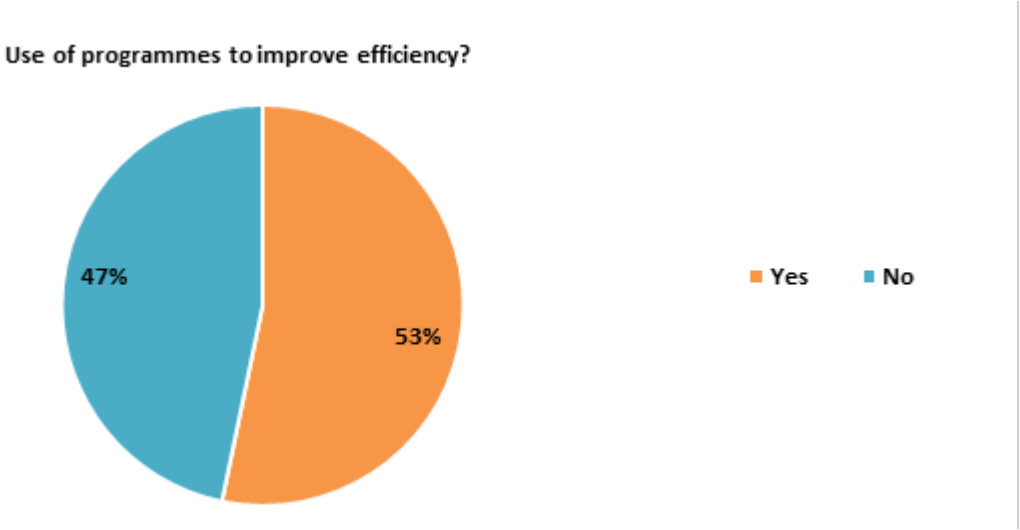


Figure 44 – Results of the online survey indicating the proportion of survey respondents who use improvement programmes to improve efficiency



The full list of points under Theme 3 which were highlighted by the interviewees are summarised in Table A-5.

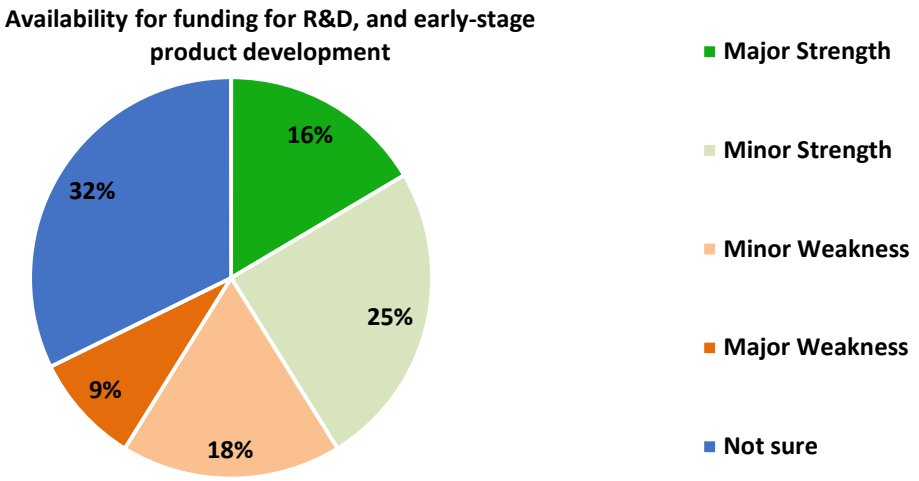
Theme 4: Government engagement

A number of key issues emerged from the interviews, touching on the stronger and weaker aspects of Government support, as well as opportunities and threats envisaged for the future. The most prominent issues raised by the interviewees and covered by the survey are discussed in more detail in the sub-sections below

Early stage technological innovation

Interviewees generally felt that support for early stage technological innovation and product development (e.g. innovation funding, Research Council grants, etc.) is strong. The AGP and ATI's role in helping to provide vital funding for technological innovation was highlighted, as well as their streamlined and effective processes for resolving specific issues to promote continued success in the industry. Coupled with a strong capability in aeronautical engineering and a tradition of innovation in the UK, there was a generally positive view of the pipeline of new technology innovation in the UK, for example from Universities or SMEs. The results of the online survey corroborated this view, with 41% of survey respondents agreeing that Government funding for early stage product development is a strength for the UK aerospace supply chain, compared to only 27% identifying this as a weakness, as shown in Figure 45.

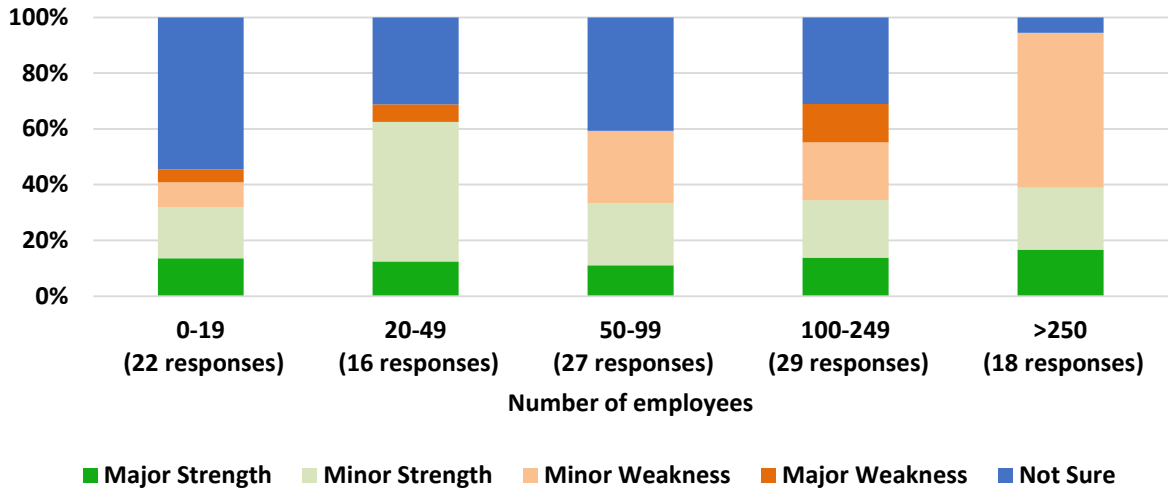
Figure 45 - Results of the online survey with respect to the availability of funding sources for research and development, and early-stage product development



When this is further disaggregated by company size, some variation can be observed. In most cases, between 30 and 40% of survey respondents indicated that the availability of funding for research and early-stage product development is a strength for the supply chain. However, smaller companies had a much higher 'Not sure' response rate than did larger companies, whilst the larger companies were more likely to believe that the availability of funding of this type is a weakness, as shown in Figure 46. Indeed nearly 60% of the smallest companies were unsure about the availability of funding in this area, whilst nearly 60% of the largest companies indicated that this is a weakness for the supply chain. The high rate of "not sure" responses amongst the smaller companies may indicate a limited awareness within such companies of the availability of these funding streams.

The reason for the discrepancy between the largest survey respondents (i.e. >250 employees), and the views of the interviewees is not clear.

Figure 46 - Results of the online survey with respect to the availability of funding sources for research and development, and early-stage product development, disaggregated by the number of employees as a metric for company size



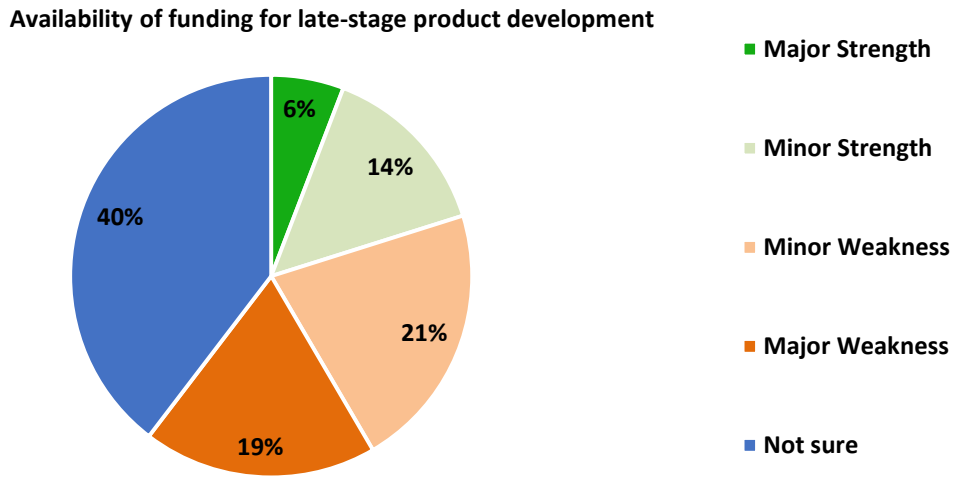
Support for late stage product development, accreditation/certification and productisation of concepts

In contrast to early-stage development funding availability, the view of the interviewees was that Government support and funding for late stage product development and productisation is somewhat lacking[11]. Support is needed in order to turn concepts into products, to gain the necessary accreditation and certification for use in the aerospace industry and to invest in setting up high capacity production lines for new products.

As a result of this perceived lack of support, the view of interviewees was that whilst many new concepts are developed in the UK, the pipeline of innovative, accredited customer-ready products that offer a real improvement in value proposition for prime contractors is limited, with the majority of these coming through international markets. Interviewees highlighted the need for major investments by Tier 1 suppliers, supported by Government where necessary to deliver the kinds of new products and associated manufacturing facilities required to secure new aircraft programmes. Figure 47 shows that survey respondents' views are generally in line with those of the interviewees, with only 20% of survey respondents viewing Government support for late-stage product development as a strength, compared to a much larger 40% viewing this as a weakness.

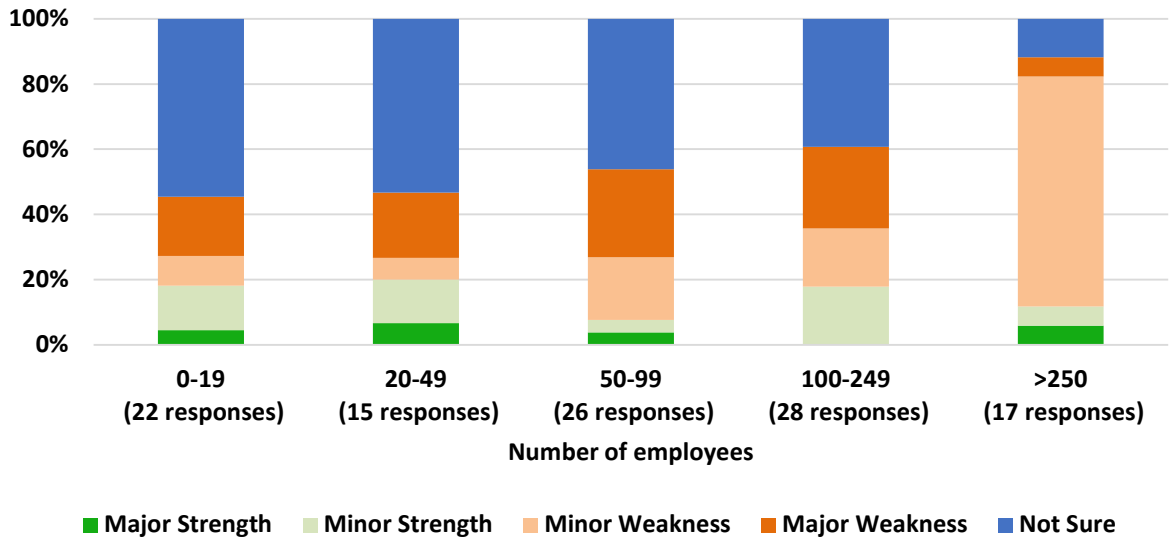
[11] Whilst the definition for late-stage product development was not explicitly defined in the interviews or survey, it was generally referred to as Technology Readiness Level 7 and upwards.

Figure 47 - Results of the survey with regards to the availability for late-stage product development



As with early-stage and research and development funding phases, increasingly negative views in relation to late-stage product development support are observed with increasing company size (see Figure 48). Over 75% of survey respondents with over 250 employees indicated that the availability of late stage support is a weakness to the supply chain, whilst smaller companies have a much less negative view, but also a much higher proportion of 'not sure' responses. This may illustrate a lower dependence on Government support for late-stage product development as most of their "products" are bespoke items produced for specific contracts, whilst the largest companies that require the largest investments are likely to have the greatest need for Government support.

Figure 48 - Results of the survey with regards to the availability of funding for late-stage product development, disaggregated by the number of employees, as a metric for company size



Support for upskilling staff

The interviewees generally felt that support available from Government for up-skilling of staff is adequate. For example, support is available for apprenticeship schemes which are viewed as vital to the continued success of the sector. However, the planned imposition of an apprenticeship levy was seen as a threat to the continued success of apprenticeships.

In contrast, the survey respondents had a very mixed opinion as to the availability of funding for the upskilling of staff, with 36% considering this a strength for the supply chain, whilst 44% consider this to be a weakness, as shown in Figure 49.These results may indicate that the availability of funding for upskilling staff, whether through apprenticeship schemes, or the improvement of the current workforce, is more readily accessible to the upper tiers of the supply chain. Indeed, many of the interviewees agreed that much of the talent is drawn to the upper-tiers, and despite a surplus of talent for these companies, companies in the lower tiers often struggle to attract interest. Smaller companies also highlighted the complexity of accessing funding as a potential barrier.

Using the total number of full-time UK employees across all sites as a metric for the size of a company, it can be seen that the larger companies support the opinions of the prime contractors and key suppliers that the availability of funding for upskilling of staff is readily accessible. For companies with over 250 employees across UK sites, 50% believe that the availability of this funding is a strength for the supply chain, whilst for the smallest companies (less than 19 employees), only 28% hold this view, and there is a significantly higher proportion of companies responding ‘not sure’, which suggests they are less aware of the availability of funding.

Figure 49 - Results of the survey with regards to the availability of funding for up-skilling of staff

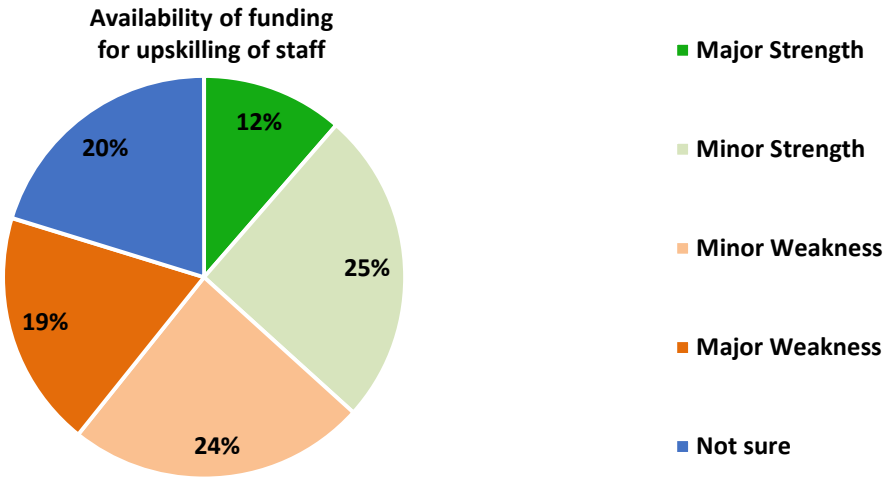
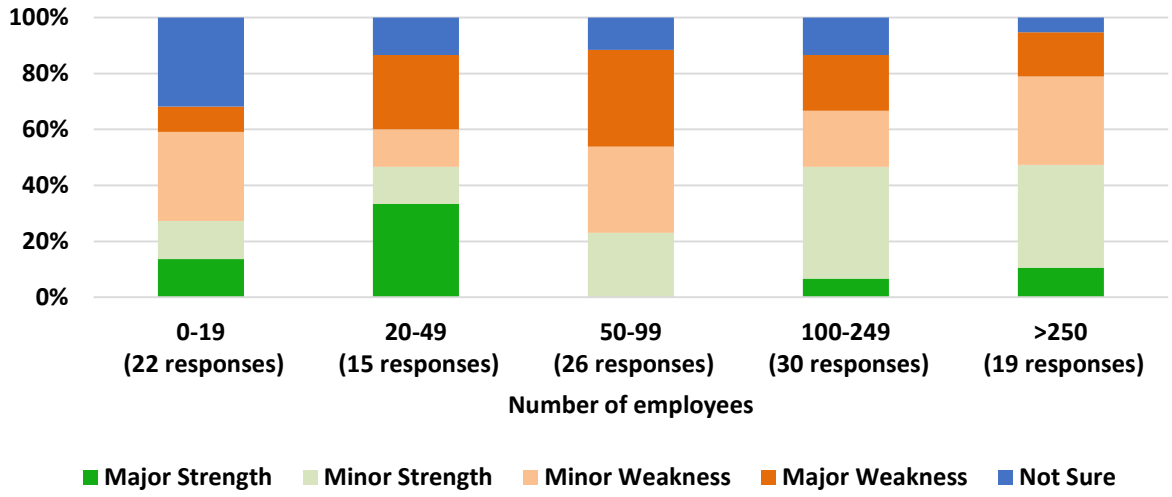


Figure 50 - Results of the survey relating to the availability of funding for up-skilling of staff disaggregated by the number of full-time employees across all UK sites for a particular company.

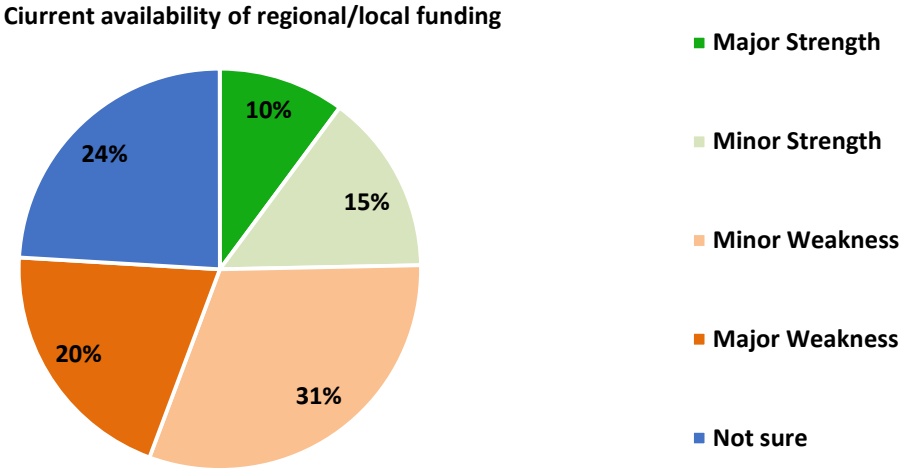


Availability of regional/local funding

Interviewees generally agreed that sources of regional and local funding are declining in general (relative to locations outside of UK). They expressed concerns that local funding streams were overly complex, and that systems for applying and awarding funding were ever changing, sympathising that this may make regional funding streams less accessible for the lower tiers and SMEs. In addition, the amount of funding available varies by region, with Wales and Northern Ireland standing out as areas where funding is more readily available.

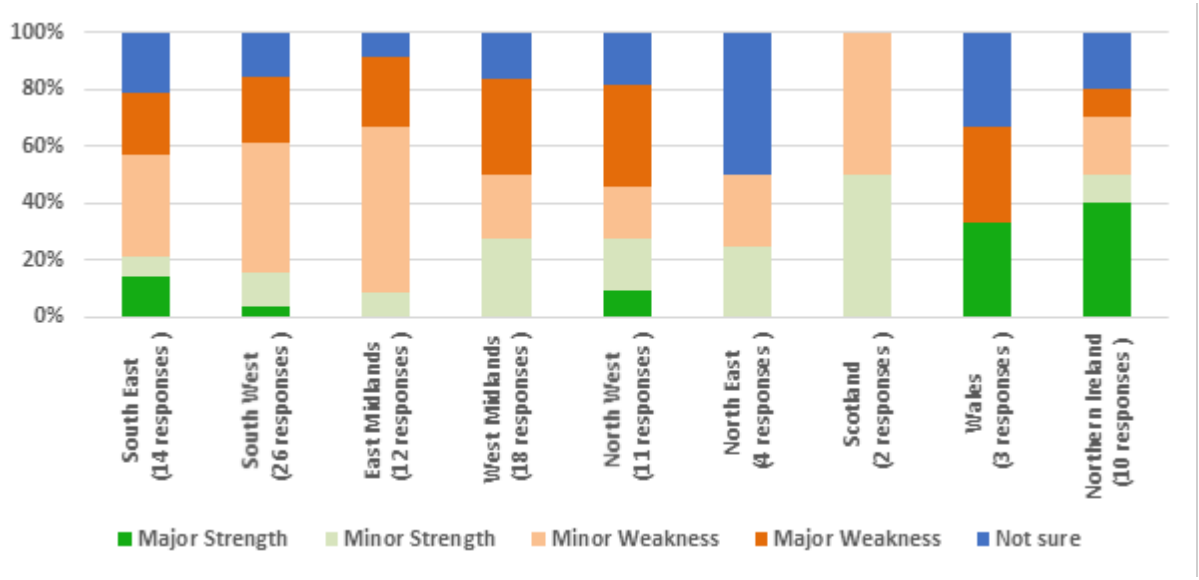
This is reflected in the results from the survey respondents, with around half of respondents indicating that this funding stream was a weakness to the UK supply chain, and only 25% expressing this as a strength.

Figure 51 - Results of the online survey for the availability of regional and/or local funding for the supply chain



When disaggregated by region, the results of the survey support the view that availability of regional funding varies significantly between regions. The north of England and Scotland indicate that regional funding is a weakness for the supply chain, whilst those in the south of England indicate a more positive view towards its availability. Wales and Northern Ireland indicate that regional funding is readily accessible.

Figure 52 - Results of the online survey for the availability of regional funding sources, disaggregated by the region that the respondent is based in

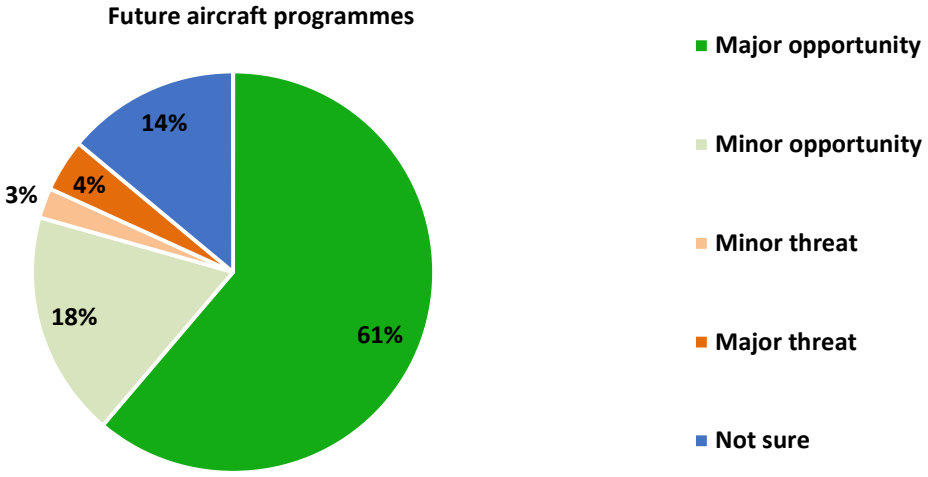


Future aircraft programmes

The prime contractors and key suppliers saw future aircraft programmes (e.g. beyond the current Airbus A350 and A320neo programmes) as major potential opportunities for the UK, however they expressed serious doubt about the ability of the UK to access these opportunities. As well as significant investments by major Tier 1s and improvements in productivity to make UK suppliers more competitive, they saw a need for strong early Government engagement with airframe manufacturers on new aircraft programmes, and for Government policy to continue to align itself with these programmes. It was frequently stated that in order for the UK to secure a major stake in these programmes, major financial support (e.g. in the form of Repayable Launch Investments or grants) would be required e.g. for upgrading manufacturing facilities to cope with the new programmes. Without this investment it was seen as likely that the next round of major aircraft programmes would mainly benefit supply chains outside of the UK.

As Figure 53 clearly demonstrates, the majority of the suppliers also view future aircraft programmes as a major opportunity for the UK. In all, 61% see this as a major opportunity for the UK aerospace supply chain, and in total 79% responded positively, with only 7% viewing this a threat of any kind. As discussed earlier, this illustrates the potential disconnect between the upper and lower tiers in terms of understanding what may be required to access major future growth opportunities.

Figure 53 - Results of the survey regarding future aircraft programmes



The main points under Theme 4 which were highlighted by interviewees are summarised in more detail in Table A-6.

Conclusions and next steps

Ricardo Energy & Environment led a study into the structure, issues and opportunities associated with the UK civil aerospace supply chain, supported by a Steering Group which consisted of BIS, ADS, ATI and a representative of the RAAs.

The results of an extensive online survey and interviews with prime contractors and other key UK aerospace suppliers have allowed for a comparison of the views and opinions from all areas of the UK civil aerospace supply chain. In addition, the quantitative element of the survey has allowed for the comparison of key turnover and procurement figures between prime contractors and the remainder of the supply chain. A number of key points were highlighted from the analysis, including:

- **Overall, the UK aerospace sector is growing, but it is not keeping pace with global growth**. Recent years show that whilst UK aerospace spend from prime contractors and major Tier 1s is growing at a rate of c. 1.4%, growth in global aerospace spend is growing much faster, at a rate of c. 5.2%. Whilst this UK growth paints a reasonably healthy picture of the UK aerospace supply chain, the results indicate that the UK is losing market share to overseas competitors and is not maximising its opportunities for growth, a trend which appears likely to continue into the future.

- **There is a shortage of manufacturing and advanced technology skills in the UK.** Whilst core aeronautical engineering skills are seen as strong within the UK, there is a shortage of skilled manufacturing engineers and advanced technology skills. It has been noted that a poor perception of manufacturing careers and resulting poor provision for these skills in education may be a contributing factor. This lack of talent has meant there is strong competition between prime contractors, major Tier 1s and from other industries that require similar skill-sets (e.g. automotive), further amplifying the problem. By contrast, the survey respondents' view is more mixed, with approximately equal numbers viewing these skills as a strength and a weakness for the UK aerospace supply chain. The reasons for this discrepancy may be associated with a lower demand for advanced technology and manufacturing engineering skills in the lower tiers of the aerospace supply chain.

- **New aircraft programmes and technologies can be a major opportunity, but the UK is not well positioned to access this opportunity.** In the future, new aircraft programmes are likely to feature substantially different products, spurred by competitive dynamics, cost demands of airlines and the need to reduce the environmental impact of aircraft. The survey respondents view developing capability in new aircraft technologies for future programmes as a major opportunity for the supply chain, with 79% of respondents observing future aircraft programmes as an opportunity. The interviewees also recognised this as an opportunity, but were concerned that the UK aerospace supply chain is not well positioned to benefit from a major stake in a new aircraft programme. They felt that major investments are required by UK-based Tier 1s and prime contractors, with the support of Government, into upgrading manufacturing capabilities. Additionally, they felt that some smaller suppliers lack the capabilities to access these opportunities through

export markets. These results indicate a potential disconnect between the views of the interviewees and the lower tiers of the supply chain with regards to the opportunities presented by new aircraft programmes in particular.

- **A lack of advanced manufacturing and lean supply chain management is leading to lack of global competitiveness**. In order to compete with low-cost emerging markets and highly-productive advanced economies, continuous improvements in quality and productivity are needed. The interviewees indicated that a lack of streamlined manufacturing processes and advanced supply chain management are weaknesses for the supply chain, and are leading to a lack of global competitiveness. The survey respondents' views were, again, more mixed, potentially highlighting a lack of awareness of the need for continuous improvement and adoption of advanced supply chain management and manufacturing capabilities amongst the lower-tiers.

- **Lower-tier companies may lack the management structure and processes required to achieve growth**. The survey responses indicate an ambitious UK aerospace supply chain, with 78% indicating they are either already growing, or are planning future growth. This is in direct contrast to the view of many interviewees, that many suppliers are either unwilling to grow, or lack the continuous improvement programmes necessary to effectively manage growth. Within the survey respondents, only 53% of the respondents indicated that they use at least one form of improvement programme for efficiency, supporting the interviewees' views on the lack of appreciation of the need for such programmes. The interviewees also expressed the view that whilst improvement programmes, such as SC21, are highly beneficial for improving competitiveness, they are only a first step and follow-on programmes are required to achieve global excellence. Additionally, a lack of business acumen, supply chain management, support functions and sales and marketing strategy were identified as contributing factors to the apparent limited ability to grow within the lower-tiers. It is likely that these apparent deficiencies are leading to the falling UK market share identified earlier; these results also support the view that there is a disconnect between the upper and lower tiers of the aerospace supply chain with regards to understanding what is required to grow in the global market place.

- **Prime contractors and lower tier suppliers have different views on the barriers to growth in the global market**. Again, this aspect of the interviewees' and lower-tier's responses supports the apparent disconnect between the views of the upper and lower tiers of the UK aerospace supply chain. The results of the survey indicate that the main barriers to growth for the UK aerospace supply chain are the length of contracts with prime contractors and the availability of skills and training. In particular, the procurement behaviour of the major companies was found to be a significant weakness for the supply chain, a view shared by survey respondents of all sizes. Demanding contractual terms and conditions, and payment structures, were concluded to have contributed to this opinion. The interviewees did also recognise the impact of their complex procurement processes, but did not see them changing in the near term. They instead identified the other issues, as outlined above, for restricting growth within the lower tiers.

- **Strong support for early-stage product development is available, but less so for late-stage development.** Both interviewees and survey respondents felt that Government support for research and development, and early stage product development, is readily available. However, they felt that funding sources for late-stage product development is less apparent. Whilst the survey respondents did, in general, agree with the interviewees here, the large proportion of “not sure” responses may indicate a lack of awareness of opportunities for support. Interviewees also considered funding for the upskilling of staff as readily available, an opinion that was somewhat shared by the survey respondents, although here the results were more mixed.

Overall, the quantitative results indicate a reasonably strong growth in the UK aerospace supply chain and an optimistic view of future growth from the lower tiers. However, there is a clear difference of opinion between the developments that the prime contractors and major Tier 1 suppliers consider are required to access the major growth opportunities identified and the apparent capabilities and plans of the lower tiers. This is contributing to a reducing UK share of the global aerospace supply chain market in the face of lower costs and higher productivities in many emerging and advanced economies and a strong willingness to invest from some overseas governments.

Appendix 1 – Detailed description of methodology

Stage 1 and 2 interviews

Prior to the start of the study, BIS had contacted a number of Primes and major Tier 1 suppliers, based on those headquartered in the UK and overseas, requesting that they complete a survey to obtain information on their supplier spend within the UK aerospace supply chain and their key global suppliers. This survey also aimed to identify the specific barriers and opportunities that they could envisage for the UK aerospace supply chain going forward. To follow up on this survey, Ricardo Energy & Environment arranged interviews with a number of these Primes and major Tier 1 companies, to understand their views on the state, structure and the connectivity of the UK aerospace supply chain in more detail. The quantitative information gained from BIS's survey was aggregated and anonymised before it was provided to Ricardo Energy & Environment. It subsequently formed a part of our Stage 3 analysis, as described in more detail in "Stage 3: Survey questionnaire".

The interviews held with prime contractors are summarised in Table A-1.

Table A-1 – Summary of interviews conducted with the prime contractors and major Tier 1s identified by BIS

Company	Date	Location
Agusta Westland	19 January 2016	Yeovil
Airbus	09 February 2016	Conference Call
Aircelle (Safran Group)	11 February 2016	Conference Call
Boeing	18 February 2016	Conference Call
Bombardier	02 February 2016	London
General Electric	27 January 2016	Cheltenham
GKN	08 February 2016	Conference Call
Labinal Power (Safran Group)	02 February 2016	Conference Call
Messier-Bugatti-Dowty (Safran Group)	12 February 2016	Conference Call

Company	Date	Location
Rolls-Royce	08 January 2016	London
Thales	11 January 2016	London
United Technologies Corporation	19 January 2016	Wolverhampton

The structure of the discussions with the prime contractors was designed to cover a broad range of areas, including labour force, availability of public and private funding sources, technology, and material availability within the UK and supply chain interactions. Information was consolidated into a SWOT (Strengths, Weaknesses, Opportunities and Threats) structure for each interviewee.

The responses and the feedback obtained during the interviews were then categorised, anonymised and collated into a series of over-arching themes which capture the major elements of the views and opinions discussed. These themes are aligned with a number of the AGP working group focus areas, as summarised below:

- Theme 1: Labour force (Skills AGP working group)
- Theme 2: Technology and material availability (ATI)
- Theme 3: Supply chain interactions (Supply Chain and Manufacturing AGP working groups).
- Theme 4: Government engagement (Strategy and Engagement AGP working groups)

The final aggregated and anonymised SWOT analyses are discussed in further detail in Appendix 3 “Complete SWOT tables”.

Within these interviews, a number of key suppliers and SMEs were identified, and further interviews were arranged with these suppliers. This formed Stage 2 of the project. The companies interviewed at this stage are summarised in Table A-2. The outputs from these interviews were structured and summarised in the same way as those of the Primes and major Tier 1 supplier interviews.

Table A-2 – List of suppliers interviewed

Interview Date	Supplier	Operation
12 January 2016	AirBorn	Electronic connectors
13 January 2016	Nasmyth	Machining, assembly and fabrication

Interview Date	Supplier	Operation
15 January 2016	MEP	Moulding and machining
18 January 2016	AVPE	Precision machining
29 January 2016	Gardner Aerospace	Detailed metallic parts
01 February 2016	Astute Electronics Limited	Electronics distribution
16 February 2016	SKF (UK) Limited - Aerospace Division	Bearings
26 February 2016	Hexcel Composites Ltd	Composite structures manufacture and assembly

In addition to the qualitative discussions, these Stage 2 companies were asked to complete a quantitative online survey containing a series of questions related to each company's business operation and procurement, in an effort to feed into our analysis of the flow and connectivity of the UK supply chain. This survey later formed the basis of the full survey, the development of which is discussed in "Stage 3: Survey questionnaire".

Stage 3: Survey questionnaire

Overview of questionnaire

The third and final stage of the study was to develop and distribute an online survey to a large database of UK aerospace supply chain suppliers. The target audience for this survey was companies directly involved in the handling of flying parts[12], as defined in "Scope of the Study" above, and was composed mainly of smaller companies in the UK aerospace supply chain, including a number of SMEs. The survey was collaboratively designed with the project's Steering Group and contained 25 questions which covered quantitative data, such as turnover, procurement spend, and employment, as well as capturing qualitative information. The qualitative questions were loosely structured on the aspects highlighted by the interviewees, aiming to either verify or refute the findings of these earlier stages. A full copy of the survey can be found in Appendix 4 –Online survey.

The purpose of the quantitative section was to capture the flow of spend through the supply chain, in order to assess to what extent value is added by the UK aerospace supply chain, its geographic extent and technological focus, as well as how much of the total spend of the end-customers reaches the UK's lower-tiers. Questions focused on

[12] Flying parts here refers to any part or product that contributes to an aircraft, whether moving or not-moving.

companies' turnover and procurement figures, their employee numbers, site distribution and product focus, as well as key suppliers and customers for each company. The qualitative section explored the opinions of the respondents on themes that had been established through the earlier interviews with prime contractors and major Tier 1 companies. In order to allow for subsequent analysis, this section was presented as a series of multiple choice questions, but with the added option to expand upon responses in an accompanying free text-box. For example, for a question that looked at the strengths or weaknesses of the current supply, the respondent was asked to assess whether a theme was a "Major Weakness", "Minor Weakness", "Minor Strength", "Major Strength" or "Not Sure". These questions covered a range of themes that had been identified from the earlier interviews, such as the current skills of the workforce and the availability of funding.

To build the database, contact details were provided by ADS and the RAAs, supported by input from BIS and the ATI. The final database contained 884[13] companies that were identified as involved directly in the manufacture of aerospace products as defined in the study's scope (see "Scope of the Study").

After reaching an agreement over the structure and the content of the survey with the Steering Group, the survey was distributed to a small pilot group of nine companies, on 12th February 2016. These companies were selected as they had demonstrated explicit interest in the project, by requesting a copy of the survey via email. In order to assess the functionality of the survey and to allow for any required changes, feedback on the structure, length, and clarity of the survey was requested. A number of minor issues were identified and addressed based on feedback received from the pilot group and the survey was cleared for distribution to the remainder of the contacts in the database.

An initial email was sent to the remaining contacts in the database on 22nd February 2016. This communication provided a brief overview of the project and the survey, providing information on the data needed in order to fully complete the survey. The live online survey link was then distributed to the full set of contacts, followed by regular reminder emails, in an effort to encourage a high-response rate. In addition to direct communication through the survey website, ATI, ADS and the RAAs promoted the survey to their own members through advertisements on their websites and direct communication via email, at events and in some cases via phone call**.** Initially, the deadline for completion of the survey was 15th March 2016, leaving sufficient room for extensions if necessary. In order to accurately capture a bottom-up view of the supply chain, it was important to achieve as high a response rate as possible, so a number of deadline extensions were agreed with the Steering Group on a weekly basis, with a final deadline of 8th April. During this time, reminders were sent to contacts who had not responded and partial respondents were contacted by phone, when possible, to understand the reasons for the partial completion and to encourage complete responses.

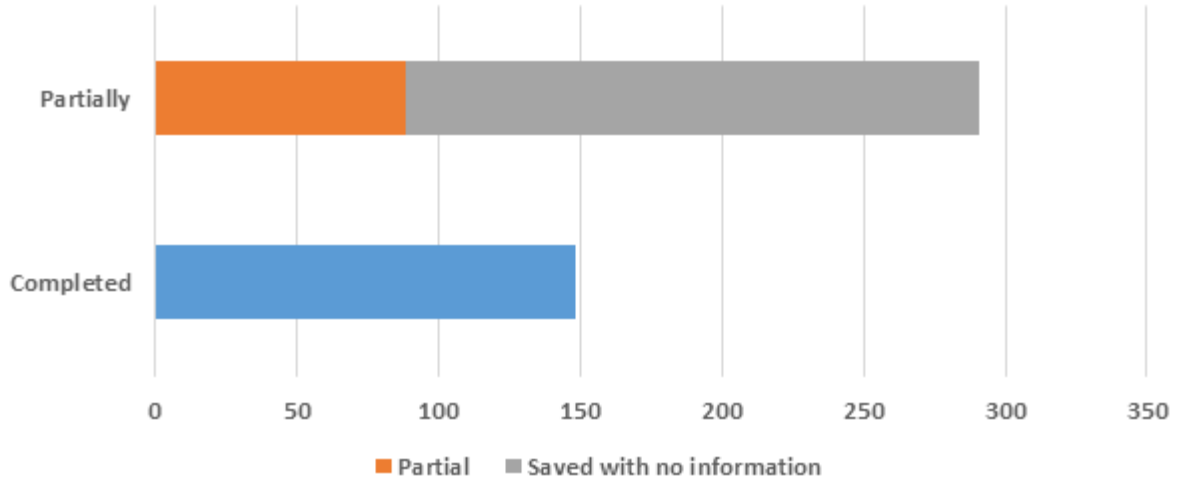
[13] The original database comprised 980 unique companies. In response, 30 were immediately identified as not relevant for the survey (e.g. law firms, consultants). A further 37 later identified themselves as not relevant through their response to us, whilst a further 29 contact details were outdated or invalid.

Response rate achieved

Of the 884 relevant contacts that the survey was sent to (plus those who received it directly from one of the RAAs), 148 completed the survey and a further 88 provided a partially completed responses. Of the contacts in the collected database, a total response rate of 25% was achieved[14]. In addition to these responses, a large number of responses were blank, indicating that the emails had reached the participants, who had taken the step to access the survey. Taking these into account, this provides a maximum outreach rate of 47%. These figures do not include the responses from the RAA which contacted its members directly.

Figure A-1 shows this information graphically. A number of contacts explicitly asked to be removed from our database, or unsubscribed from the email thread. This was for a variety of reasons, the most common of which was due to the fact that the company in question was not directly involved with handling aerospace parts (for example management or recruitment consultancies, and law firms), leaving a total of 884 relevant companies within the scope of the study.

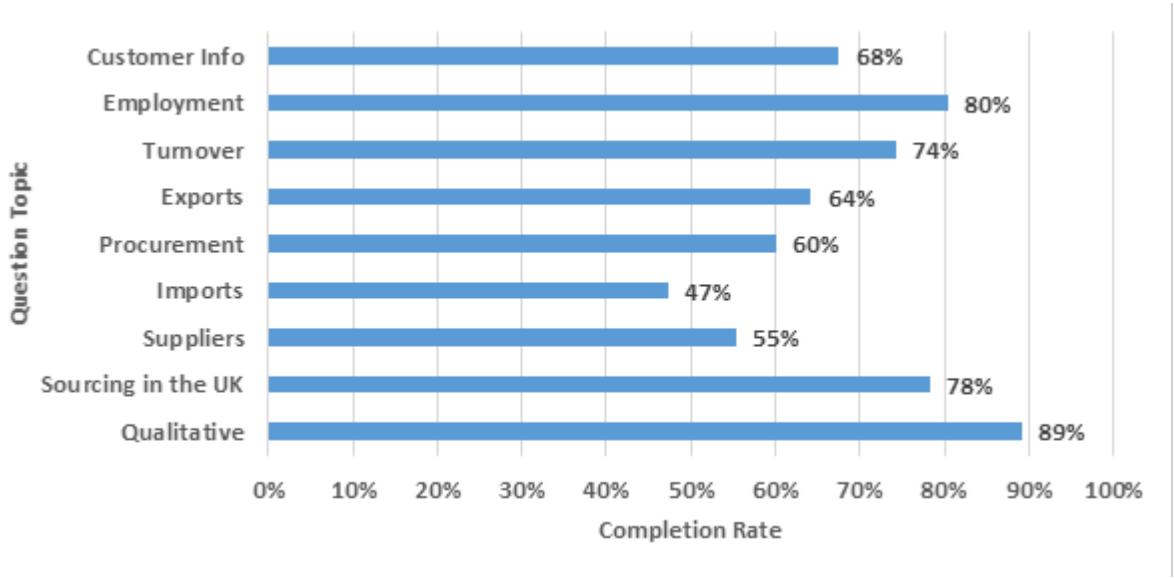
Figure A-1 The number of respondents to the survey, including those who have accessed the survey, but exited before entering any information



Some others expressed a concern over the commercial sensitivity of the data and were uncomfortable completing the survey. In an effort to overcome this, it was communicated to all respondents that all data would be anonymised and aggregated before submission, and that these questions were not mandatory and could be skipped. Looking more closely at the response rates by question corroborates this general concern. Figure A-2 shows the response rate by the broad topic of the question. Response rates of 89% were achieved for the qualitative questions, by contrast, these rates drop to around 50% for information on imports and suppliers.

[14] A total of 14 responses could not be attributed to contacts on the database, and are excluded from this calculation

Figure A-2 – Response rate by topic



Appendix 2 – Consistency of the online survey with National Statistics

The original intention of the project was to apply a random probability sampling approach to a database of all UK aerospace supply chain members to generate a sample of suppliers within the UK aerospace supply chain. This approach would make the survey results representative of the population. However, to be applied, the database of suppliers must be complete. Estimations of the true number of aerospace supply chain members varies greatly, and it is not possible to determine the completeness of the database with confidence. Therefore, it was necessary to instead adopt a non-probability convenience method. This method, unlike probability sampling, does not involve random selection. Rather, the survey is distributed to all known suppliers from the database, offering a more practical solution. As a result of the adoption of this approach, the results of the survey may exhibit some biases (related to the identification of suppliers for the database and the particular companies which responded). A comparison was made of the survey sample to a few of the characteristics of the UK Aerospace Sector as a whole collected as part of the Official National Statistics.

Significance by turnover

One comparison that can be made to demonstrate that the sample of respondents is consistent with the population is to compare the turnover of suppliers (with export sales removed) with the procurement figures from the BIS prime contractor and major Tier 1 survey (discussed further in Primes views). The total UK procurement figure from the BIS survey to prime contractors is £7.3bn. This, however, includes inter-prime spend, and so the total figure that reaches the supply chain is likely to be significantly lower. At this stage, it is not possible to determine how much lower this figure is in reality, and so direct comparisons have been made.

In total, the survey captures £2.2bn of turnover[15]. Of this value, £1bn was identified as exports, while £1.2bn was identified as sales to UK customers. It should be noted, however, that these figures, particularly the sales to UK customers, may also include some double counting.

Using a simple metric of comparison, the survey has captured 16% of supply chain spend of the prime contractors. Given that 88 respondents completed the quantitative section of the survey, then this spend has been captured by a maximum of 10% of total suppliers, although this is likely to be less. This may therefore indicate that the respondents to the survey are biased towards larger companies, although there remains significant uncertainty around this conclusion.

[15] Including only responses which provided sufficient information to assign turnover to UK sales and exports. If this initial filter is not applied, the survey has captured £3.5bn

Significance by employment

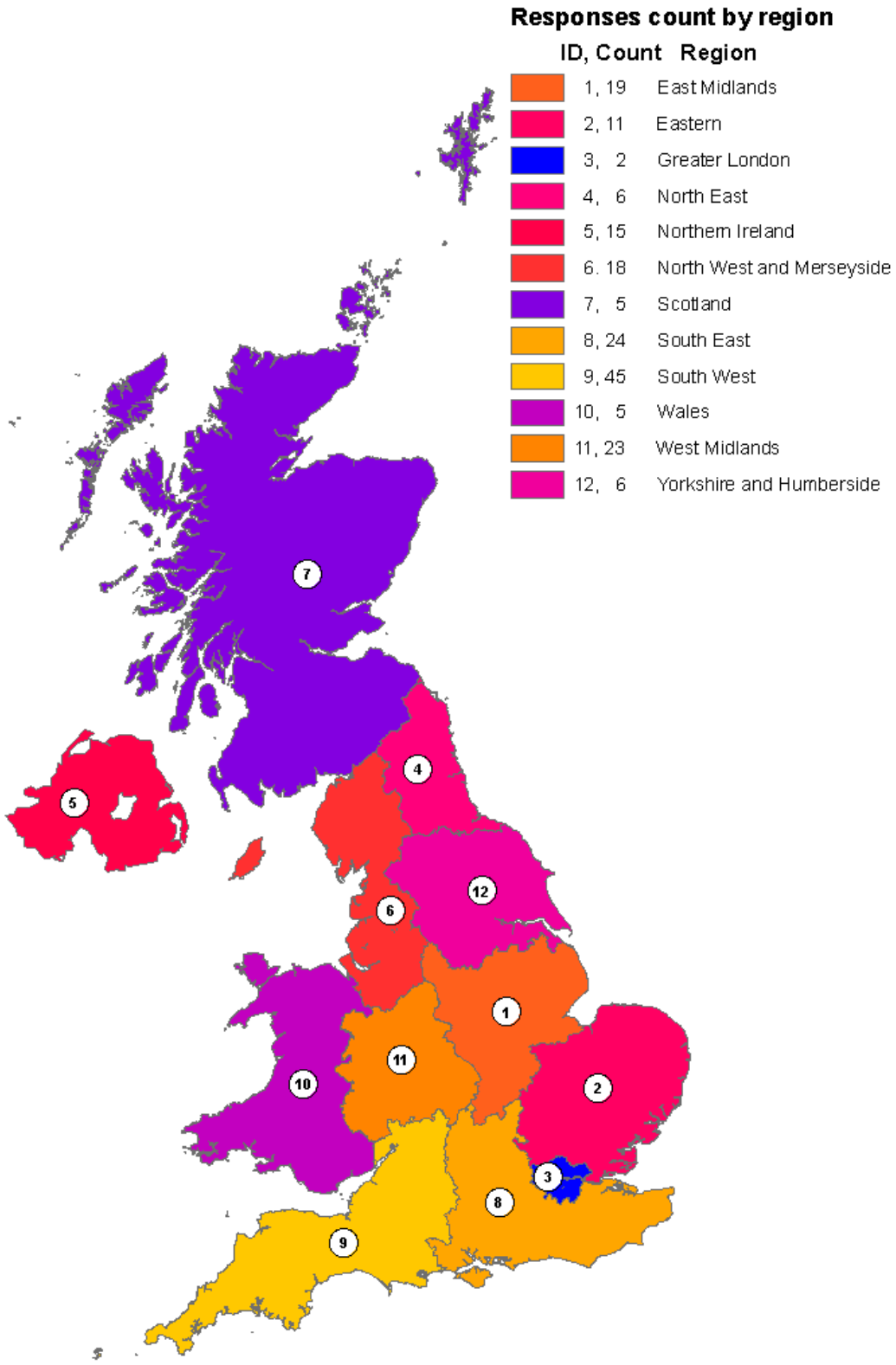
Another check can be made by comparing the coverage of employment from the survey and published figures for direct aerospace employment. In total, the survey captures companies with over 27,000 full-time equivalent employees in the aerospace supply chain. The ONS figure for direct aerospace employment in 2015 is 116,000[2], although this figure includes those who fall outside of the scope of this project, such as employees of maintenance and repair organisations, as well as those working for prime contractors and major Tier 1 companies. However, using these figures as an approximate gauge to the extent to which the supply chain has been captured indicates that 23% of the workforce is represented in this survey.

Regional significance

Figure A-3 illustrates the results of employment by region from the survey. ONS figures from 2013 indicate the most significant clusters for aerospace within the UK are East Midlands, South West, and North West. This distribution is captured to a reasonable extent by the response rate and employment rates disaggregated by region. The South West, South East, West Midlands and East Midlands are the largest contributors to responses to the survey, reflective of the ONS figures[16]. There are some discrepancies however. The West Midlands and South West appear to be over-represented in the survey, whilst the North West is under-represented.

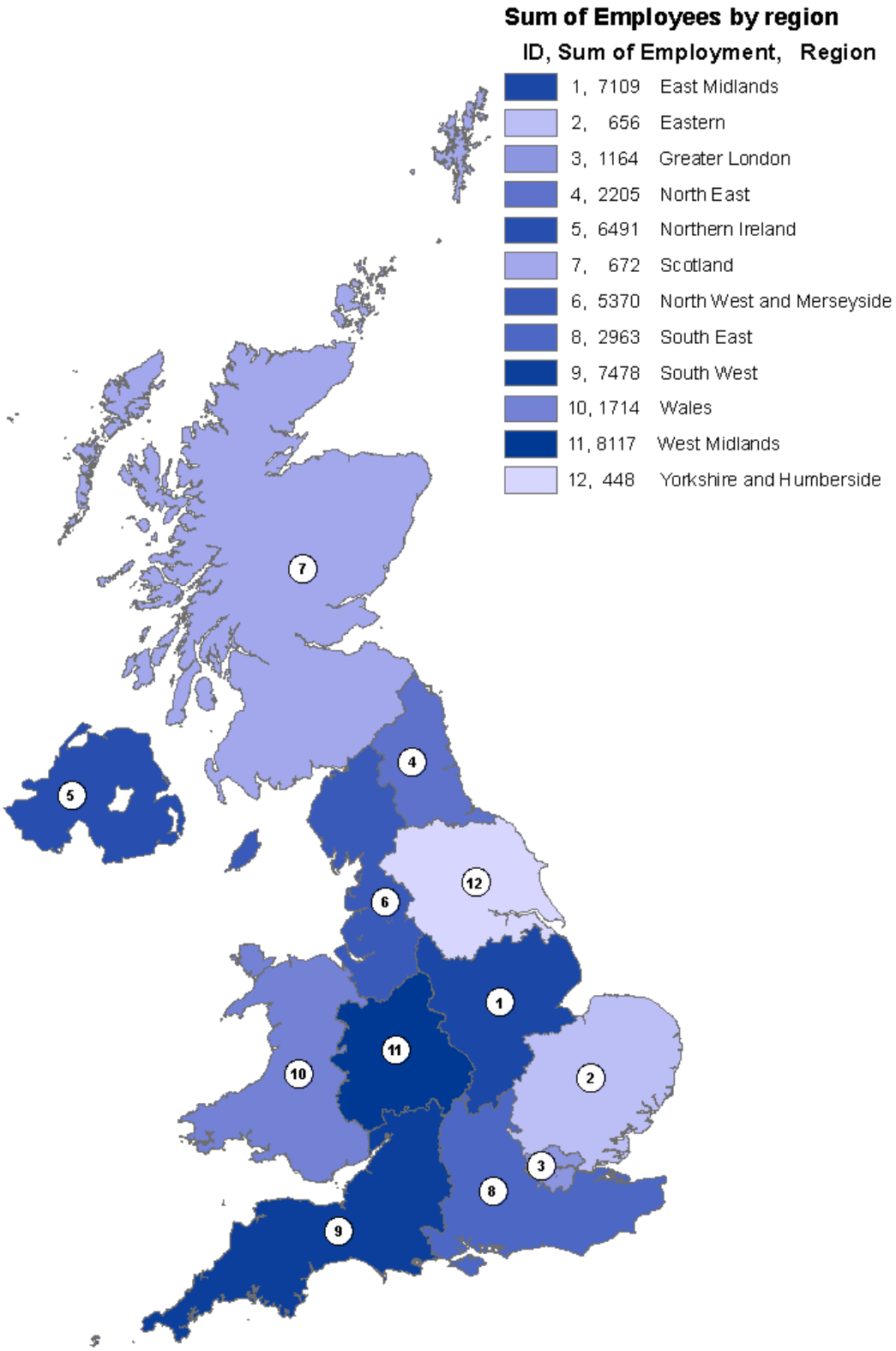
[16] ONS ABS 2013

Figure A-3 – Response rate count by region from the online survey



Additionally, when employment is considered, as in Figure A-4, the largest regions of employment captured by the survey are the South West, West Midlands, East Midlands and North West. This, again, reflects the distribution described by the ONS figures.

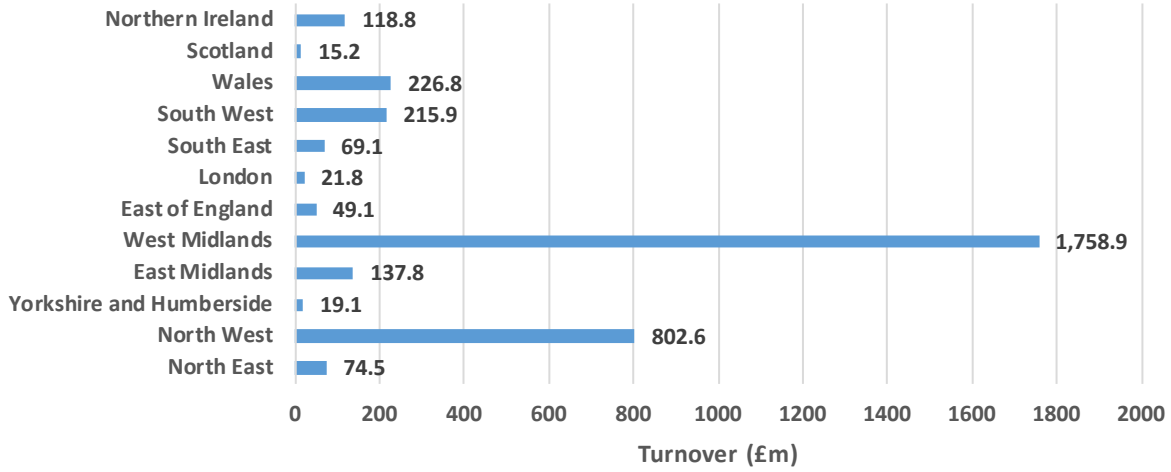
Figure A-4 - Employment count by region from the online survey



A final way of demonstrating representation is to consider the regional distribution of civil aerospace turnover. As Figure A-5 shows, there is a major over-representation of the West

Midlands in comparison to the ONS figures. Given that the number of responses from the region is similar to others, this results show the companies from the West Midlands who responded to survey are companies with large turnovers. Beyond this, the largest regions are the North West, South West, Wales and the East Midlands. The North West and Wales are perhaps slightly overrepresented in this picture.

Figure A-5- Civil aerospace turnover by region from the online survey



Conclusions

Through this first-order comparative analysis with information from other published sources, it can be seen that, whilst there is some minor bias identified, the respondents are, on the whole, consistent with the aerospace supplier population in general. Small biases identified include those towards larger companies, in particular in the West Midlands, an overrepresentation of the West Midlands and an under-representation of the East of England and Scotland. However, since the general distributions of each of these comparisons matches those of published figures to a large extent, it is concluded here that the results of the survey are consistent with the population as a whole.

Appendix 3 – Complete SWOT tables

Theme 1 – Labour force

Table A-3 – SWOT analysis from Stage 1 and 2 interviews on labour force

Strengths	Weaknesses
• High-profile major companies in UK attract top talent. • Strong apprenticeships and graduate trainee programmes. • Good funding for upskilling of staff (apprenticeships, etc.), resulting in an increase in the number of workshop apprentices. • Generally good education, particularly in the field of aeronautical engineering.	• Over-emphasis on academic skills relative to practical skills, at the expense of managerial or supply chain expertise. • Insufficient focus on hands-on skills in education resulting in reduced availability of manually-skilled people entering workforce, thereby increasing the time taken for new recruits to adapt to working environment. • Manufacturing is not seen as an attractive career choice and there is a very poor emphasis on manufacturing engineering in education. • Lack of training / education for new skill requirements (e.g. data security, composite manufacturing and telecommunications) arising from the introduction of new technologies. • Excessive bureaucracy for apprenticeship funding. • Lack of procurement and supply chain management talent.

Opportunities	Threats
• Industry collaboration with local schools, colleges and universities to promote manufacturing engineering and supply chain as a career choice.	• Decline in manufacturing engineering and supply chain expertise due to these being viewed as unattractive careers – will lead to declining capability in

Opportunities	Threats
	the industry. • Increased competition for skilled workers. • Threat to UK workforce from offshoring of highly specialised and skilled jobs and increasingly skilled, lower cost emerging market workforce.

Theme 2 – Technology and materials

Table A-4 - SWOT analysis from Stage 1 and 2 interviews on technology and materials

Strengths	Weaknesses
• Tradition of advanced technology and high standards in UK. • Strong investment in research and development and capability in developing new technologies. • Agile manufacturing capability in some UK companies. • Import licences dissuading companies from sourcing offshore and favouring specialist manufacturing by UK SMEs. • Strong prime contractors and Tier 1 suppliers in UK.	• View that there are no UK suppliers of particular products (e.g. antennae, composites, composite-specific treatment, titanium machining, etc.) • Insufficient Tier 1 suppliers in UK expected to invest heavily in building capacity and accessing new aircraft programmes. • Difficulty in bringing new SME products to markets without major investment from prime contractors / Tier 1 suppliers who have approved supplier status with prime contractors – very low perceived product innovation amongst UK SMEs, despite technological innovation at earlier TRL levels. • Approved supplier lists restrict options for prime contractors when selecting the most appropriate companies when sourcing. • Out-dated manufacturing processes and other manufacturing costs (e.g. power) resulting in poor competitive position versus other more

Strengths	Weaknesses
	technologically advanced economies or low labour cost markets. UK no longer seen as being technologically advanced and large productivity gap with other leading markets. • Expensive workforce compared to low-cost countries (e.g. Far East). • Stronger Government investment in product and manufacturing capability development in other countries.

Opportunities	Threats
• Increased automation in manufacturing and new technologies (e.g. additive manufacturing) may provide opportunities – conditional on heavy investment from industry / Government. • New aircraft programmes – provided there is strong alignment of Government policy and associated investment. • New entrant manufacturers who may require products already existing on other programmes. • Increasing labour costs in emerging markets reducing their cost competitiveness. • SiG for smaller companies, and coaching/mentoring smaller supplier management teams to help them understand how to grow.	• New manufacturing and aerospace technologies (e.g. additive manufacturing, composites) may be threat if technology is invested in overseas but not (sufficiently) in UK. • New aircraft programmes – if insufficient support and investment. • Move by many prime contractors and airframe manufacturers from 'build to print' to 'build to specification' contracts, which requires much greater investment by UK Tier 1 and lower suppliers. • Competition from offshore low cost manufacturing (with low-cost workforce) with increasingly skilled workforce, e.g. South East Asia, Middle East. Some parent groups are investing in developing state-of-the-art operational capability in emerging market regions. • Offsets – increasingly being part of major sales – may lead to technology transfer offshore. • Threat to SMEs from industry

Opportunities	Threats
	consolidation and fewer / larger aircraft programmes. • Exchange rate (strong pound).

Theme 3 – Supply chain interactions

Table A-5 - SWOT analysis from Stage 1 and 2 interviews on supply chain interactions

Strengths	Weaknesses
• Ability of more local UK lower-tier companies to participate in risk and revenue sharing programmes, or to cooperate closely with prime contractors. • Willingness among some prime contractors to build relationships with these UK suppliers. • Locality of supply: o For small, niche components (and for process treatments such as coatings) can be beneficial. o Can also be important for design and development stages of new products. Often, these local suppliers will have priority when moving towards productisation. • Local enterprise centres – can be good for bringing multiple SME suppliers together • Strong supplier inertia in existing product supply chains. It is easier to develop a supplier than to change it. • Availability of improvement programmes such as SC21.	• SMEs built around technical innovation and lack management, financial and supply chain expertise – can result in poor performance for delivery on time and budget. • Poor provision amongst SMEs of secondary functions (e.g. marketing, sales, strategy, finance) that are crucial to make themselves attractive to prime contractors and secure their growth from SMEs to medium-sized businesses, thereby keeping pace with demand growth and globalisation in the industry. Lack of a commercial 'vision' amongst many SMEs. • Many lower-tier suppliers place too much focus on providing niche products and are not well placed to benefit from the increased globalisation and consolidation of the aerospace supply chain. • Limited capacity and slow turnaround at process treatment houses is a major bottleneck in the supply chain. • Difficulties faced by smaller suppliers in having their products considered by prime contractors due to the effort required in strict accreditation and auditing rules.

Strengths	Weaknesses
	• Difficulties in SMEs funding the significant commitment required of improvement programmes such as SC21 or Sharing in Growth, or other accreditation/auditing processes required by prime contractors – slow take-up of these programmes. • Risk and revenue sharing sometimes seen as requiring a lot of management (by supplier) for, potentially, little gain. • Brokers seen as route to market for some smaller suppliers, but lead to mark-ups and loss of direct relationship between supplier and customer. • Demand from some prime contractors to only deal with suppliers with large turnover or to impose onerous payment terms or contract T&Cs – can lead to mistrust from SMEs or unwillingness to work with prime contractors. • Restrictions faced in achieving preferred or approved supplier status. Approved companies are gaining significant advantages and may not be offering best value for money. • Many suppliers lack the willingness or ability to constantly evolve processes to maximise productivity. They should be setting aside funds to do this, and risk competitiveness by not • SC21 only helps SMEs reach a minimum standard, but doesn't deal with achieving excellence and international competitiveness • A lack of business acumen in SMEs prevents turning true product innovation into attractive value proposition • SMEs lack the infrastructure to win

Strengths	Weaknesses
	customers (i.e. marketing, sales and strategy teams) – too product-focussed

Opportunities	Threats
• Global ramp-up of production – provided the UK can implement modern, agile manufacturing processes. • Increased investment in improvement programmes such as SC21 to improve management and supply chain capabilities (and therefore on-time and budget performance) amongst the lower tier suppliers. • Support from Government (e.g. funding/training) to help improve commercial mindset of SMEs, e.g. marketing, sales, strategy training. • Interest in building relationships with UK suppliers by some UK prime contractors. • Potential to build relationships with offshore prime contractors as result of global growth in demand for aerospace products. • Dual sourcing by offshore prime contractors.	• Most UK-based global prime contractors select suppliers using cost/quality/flexibility-led scoring metrics and do not see particular benefit in sourcing from UK; therefore they do not proactively manage UK supply chain development. • Global ramp-up of production – if unable to prove ability to reliably supply on time or secure investment in production ramp-up, SME suppliers may struggle to get their products on these large programmes. • Dual sourcing by UK-based prime contractors may lead to offshoring of part supply. • Large numbers continue to sign up to programmes such as SC21 but without completing the process, or implementing any major changes. • Lack of management expertise in SMEs to manage growth. • 'Small company mindset' in some UK SMEs may inhibit growth. • Increasing lack of trust from the lower tiers in working with prime contractors.

Theme 4 – Government engagement

Table A-6 - SWOT analysis from Stage 1 and 2 interviews on government engagement

Strengths	Weaknesses
• Government funding availability for research and early development stages of technology • Funding for upskilling of staff (apprenticeships, etc.). • Streamlined and effective support from AGP and ATI. • Funding for improvement programmes such as Sharing in Growth.	• Limited funding opportunities for later-stage product development and manufacturing investment. • Funding for design and innovation opportunities has also declined. • High cost to SMEs and unavailability of funding for necessary accreditation (e.g. the National Aerospace and Defence Contractors Accreditation Program (Nadcap)) • Complexity of accreditation and certification processes and lack of support to work through these complex processes. • Sharing in Growth funding requires large initial investment that is not always available to lower tiers. • Non-governmental financing is difficult to obtain. • Reduced availability of Regional Funding. • Smaller companies find accessing investment funding streams difficult (particularly for smaller projects). • Large portion of funding goes to major players.

Opportunities	Threats
• Global ramp-up of production – provided the UK can implement modern, agile manufacturing processes. • Increased investment in improvement programmes such as SC21 to improve management	• Most UK-based global prime contractors select suppliers using cost/quality/flexibility-led scoring metrics and do not see particular benefit in sourcing from UK; therefore they do not proactively manage UK supply chain

Opportunities	Threats
and supply chain capabilities (and therefore on-time and budget performance) amongst the lower tier suppliers. • Support from Government (e.g. funding/training) to help improve commercial mindset of SMEs, e.g. marketing, sales, strategy training. • Interest in building relationships with UK suppliers by some UK prime contractors. • Potential to build relationships with offshore prime contractors as result of global growth in demand for aerospace products. • Dual sourcing by offshore prime contractors.	development. • Global ramp-up of production – if unable to prove ability to reliably supply on time or secure investment in production ramp-up, SME suppliers may struggle to get their products on these large programmes. • Dual sourcing by UK-based prime contractors may lead to offshoring of part supply. • Large numbers continue to sign up to programmes such as SC21 but without completing the process, or implementing any major changes. • Lack of management expertise in SMEs to manage growth. • ‘Small company mindset’ in some UK SMEs may inhibit growth. • Increasing lack of trust from the lower tiers in working with prime contractors.

Appendix 4 –Online survey

The online survey distributed to the aerospace supply chain is imaged in full below.

ID 427

Welcome to the UK Civil Aerospace Supply Chain Questionnaire

ID 426

On behalf of the Department of Business, Innovation and Skills (BIS), Ricardo Energy & Environment is carrying out a study of the UK Civil Aerospace Supply Chain. This study is also supported by the Aerospace Growth Partnership (AGP), Aerospace Defence & Security (ADS), Aerospace Technology Institute (ATI) and the Regional Aerospace Alliances (RAAs).

With the expectation that the global aerospace market is to be worth over $5tr by the 2030s, we are keen to ensure the UK civil aerospace supply chain is well positioned to secure as much workshare of this opportunity as possible. The first step of this is to understand better the current position and views of the UK supply chain.

The results of the survey will be used to understand how the UK supply chain is positioned to take advantage of this growth potential or, conversely, where there may be opportunities for support mechanisms to be developed to enable growth to take place. Your participation in this survey is valued and important.

Your responses to the survey questions will be used solely for the analysis of the Civil Aerospace Supply Chain. All figures will be held only by Ricardo Energy and Environment and will be aggregated and anonymised before sharing with BIS or any other stakeholders, or before publication of any reports based on our analysis. We fully appreciate the commercial sensitivity of your data and have taken these steps to maintain its confidentiality and security. We will share the names of participating organisations with BIS for their follow up activities.

The survey should take no more than 15-20 minutes of your time to complete. Remember that **your answers will not be saved should you leave before the end** so please have the following information to hand:

- Company turnover and procurement spend for the last financial year
- Company employees
- The above disaggregated by global, UK and primary site
- A list of your top customers and suppliers

Thank you for participating in our survey

ID 404

Company Overview

ID 135

1. Company information

Your contact details (contact name and email address) will only used for any required clarification of responses and will not be passed on to any third party.

Company Name

First Name

Last Name

Email Address

ID 141

2. Which option best describes your organisation?

- ○ Solely UK based business
- ○ UK headquartered business with overseas operations
- ○ Headquartered outside UK with UK business operations

ID 291

3. Are you involved in the design, engineering, manufacture, testing or handling of materials or components that may be fitted to civil aircraft?

- ○ Yes
- ○ No

ID 293

Please enter your main business activity

ID 294

Please enter your activities in relation to the UK civil aerospace industry (if different from above or state "none")

Operations

ID 28

This section is aimed at understanding more about your operations and the type of products you supply. The data will be aggregated to provide overarching supply chain statistics and therefore anonymised. The data will be retained by Ricardo Energy and Environment and not be passed onto BIS or any third parties.

ID 142

4. What is your main type of operation?

- ○ Design
- ○ Design and build
- ○ Build to print
- ○ Integrator
- ○ Distributor
- ○ Subcontractor processing
- ○ Testing
- ○ Other - (please specify)

ID 333

5. What civil aerospace product or service do you mainly offer?

ID 340

If other materials are used please specify

ID 297

Please select the part(s) of the aircraft where your product is incorporated.
(Please select all that apply)

Propulsion

- [ ] Combustion
- [ ] Compressor system
- [ ] Fan system
- [ ] Turbine
- [ ] Other (please specify)

Structures

- [ ] Fuselage
- [ ] Nacelle
- [ ] Tail
- [ ] Wings
- [ ] Other (please specify)

Systems

- [ ] Avionics
- [ ] Fuel
- [ ] High lift
- [ ] Landing Gear
- [ ] Power
- [ ] Other (please specify)

Others

- [ ] Interiors
- [ ] Not certain
- [ ] Other (please specify)

ID 405

Please indicate the main specific products or services you supply, separating each with a comma

ID 368

6. Does your organisation use any of the following tools or programmes to improve efficiency ?

	Yes	No	Not sure
Overall equipment effectiveness (OEE)	○	○	○
Six Sigma	○	○	○
Lean Management	○	○	○
21st Century Supply Chains (SC21)	○	○	○
Just-in-TIme	○	○	○
Enter another option	○	○	○
Enter another option	○	○	○

ID 311

7. Who are your top three customers by sales value?

	Customer name	Customer site supplied - Country	Customer site supplied - Town
Customer 1			
Customer 2			
Customer 3			

Employees and Sites

ID 303

Individual company employment details are used solely for the analysis of the Civil Aerospace Supply Chain and all data will be aggregated and anonymised before presenting to any project stakeholders or publication. The data will be retained by Ricardo Energy and Environment and not be passed onto BIS or any third parties.

ID 29

8. Currently how many FTE (Full Time Equivalent) employees work for your organisation?

Globally

In the UK

ID 39

9. Where is your primary UK manufacturing/operations site?

Town

ID 55

10. How many manufacturing and processing sites (including your primary site) do you have across the UK?

ID 258

Please indicate the towns in which these sites are located, separating them with a comma

Turnover (2014/15 annual period or nearest complete year)

ID 35

Individual company figures are used solely for the analysis of the Civil Aerospace Supply Chain and all data will be aggregated and anonymised before presenting to any project stakeholders or publication. The data will be retained by Ricardo Energy and Environment and not be passed onto BIS or any third parties.

In all cases we appreciate that exact figures may be hard to obtain and approximation is acceptable if it is not possible to state exact numbers.

ID 330

11. What is the turnover of your organisation in **million pounds sterling** for the last financial year (please enter the full number, rounding is acceptable)?

Corporate parent global turnover (or n/a)

Turnover generated from UK sites

Civil aerospace related turnover generated from UK sites

ID 60

12. Which non-civil-aerospace industries do you also supply from the UK, if any?
(Please select all that apply)

- ☐ Automation and Robotics
- ☐ Automotive
- ☐ Biotechnology
- ☐ Chemical
- ☐ Civil Engineering
- ☐ Construction
- ☐ Defence
- ☐ Electrical
- ☐ Electronics
- ☐ Energy
- ☐ IT
- ☐ Marine
- ☐ Medical and Pharmaceuticals
- ☐ Metals, Minerals, Materials
- ☐ Nuclear
- ☐ Oil and Gas
- ☐ Space
- ☐ Transport
- ☐ Utilities
- ☐ Other (please specify)

ID 61

13. Approximately what percentage (%) of your turnover from UK sites is to overseas civil aerospace customers ?

ID 190

In which global regions do you generate significant Civil Aerospace sales? *(Please select all that apply)*

- ☐ Europe
- ☐ Middle East
- ☐ Africa
- ☐ Russia and CIS
- ☐ North America
- ☐ South America
- ☐ Asia-Pacific (including Australia and India)
- ☐ China

Procurement

ID 63

Individual company figures are used solely for the analysis of the Civil Aerospace Supply Chain and all data will be aggregated and anonymised before presenting to any project stakeholders or publication. The data will be retained by Ricardo Energy and Environment and not be passed onto BIS or any third parties.

In all cases we appreciate that exact figures may be hard to obtain and approximation is acceptable if it is not possible to state exact numbers.

ID 64

14. What was your total civil aerospace procurement spend on goods and services in **million pounds sterling** for UK sites only for the last financial year (please enter the full number, rounding is acceptable)?

ID 65

15. Approximately what percentage (%) of your civil aerospace procurement for UK sites is spent on imported supplies?

ID 315

16. How many suppliers make up (approximately) 70% of your total procurement spend int the last financial year?

Supplier Information

ID 67

17. Please list your top three key global and UK suppliers in terms of procurement spend for UK sites only

	Supplier name	Country	Town
Supplier 1			

ID 342

What type of product do you buy from Supplier 1?

ID 343

Please specify the key products sourced (separating them with a comma)

ID 344

18. Please describe supplier 2

	Supplier name	Country	Town
Supplier 2			

ID 346

What type of product do you buy from Supplier 2?

ID 347

Please specify the key products sourced (separating them with a comma)

ID 348

19. Please describe supplier 3

	Supplier name	Country	Town
Supplier 3			

ID 350

What type of product do you buy from Supplier 3?

ID 351

Please specify the key products sourced (separating them with a comma)

UK Sourcing

ID 372

20. Are there any materials, products or services you would like to source in the UK but currently do not?

- ○ Yes
- ○ No

ID 407

Please list the materials, products or services you would like to source in the UK, separating each with a comma

ID 374

Please indicate WHY you do not currently source these materials, products or services in the UK.
(Please select all that apply)

- ☐ Lack of availability
- ☐ Price
- ☐ Quality
- ☐ Operational flexibility
- ☐ On time delivery
- ☐ Overseas state funding programmes
- ☐ Insufficient production capacity
- ☐ Risks associated with switching suppliers
- ☐ Complexity of supplier approval process
- ☐ Willingness to risk share
- ☐ Lack of accreditation
- ☐ Other (please specify)

Current UK Civil Aerospace Supply Chain

ID 366

In this section of the survey we would like to understand your views on the performance of the current civil aerospace supply chain. Your responses will be used for analysis of the civil aerospace supply chain only. The views expressed will be aggregated into themes and direct contributions will not be passed onto BIS or any third parties.

ID 422

21. Do you feel you have the ability to grow your UK Civil Aerospace business (e.g. capacity, footprint, etc.)?

No desire to grow	Would like to grow but can't	Spare capacity to grow but no requirement	Planning future growth	We are growing
○	○	○	○	○

ID 423

22. What are the barriers to growth? (please select all that apply)

- ☐ Length of contracts available
- ☐ Access to finance
- ☐ Lack of Government support
- ☐ Lack of skills and training
- ☐ Local planning restriction
- ☐ Ability to access export markets
- ☐ Other (Please specify)
- ☐ Not applicable

ID 424

Please comment on these or any other growth barriers

23. Please identify whether you consider the following **funding and skills** items to be strengths or weaknesses for the UK Aerospace Supply Chain.

Please note that the non-existence or non-availability of an item may be considered a weakness if its availability would be a benefit to the UK civil aerospace supply chain

	Opinion				
	Major Weakness	Minor Weakness	Minor Strength	Major Strength	Not sure
Current **funding** for research and early-stage product development	○	○	○	○	○
Current **funding** for late-stage product development and productisation	○	○	○	○	○
Current **funding** for upskilling of staff (apprenticeships, etc.)	○	○	○	○	○
Current availability of regional / local **funding**	○	○	○	○	○
Current leadership and managerial **skills**	○	○	○	○	○
Current aeronautical engineering **skills**	○	○	○	○	○
Current manufacturing engineering **skills**	○	○	○	○	○
Current supply chain management **skills**	○	○	○	○	○
Current **skills** expertise in new fields (e.g. data security, composites)	○	○	○	○	○

ID 413

Please add any additional comments or reasoning

ID 416

24. Please identify whether you consider the following **supply chain, technology and regulatory** items to be strengths or weaknesses for the UK Aerospace Supply Chain.

Please note that the non-existence or non-availability of an item may be considered a weakness if its availability would be a benefit to the UK Aerospace Supply Chain

	Opinion				
	Major Weakness	Minor Weakness	Minor Strength	Major Strength	Not sure
Level of aerospace specific accreditation / certification requirements for UK suppliers	○	○	○	○	○
Opportunity to achieve "Approved Supplier" status with customers	○	○	○	○	○
Procurement behaviour of major companies (e.g. T&C's, risk sharing, price negotiation)	○	○	○	○	○
Proximity of suppliers to customers	○	○	○	○	○
Agility / flexibility of suppliers / ability to deliver on time	○	○	○	○	○
Improvement programmes (e.g. SC21, six sigma etc.)	○	○	○	○	○
Use of the latest manufacturing engineering and supply chain processes	○	○	○	○	○
Innovation in product design	○	○	○	○	○
Availability of advanced technology research and development facilities (e.g. Catapults)	○	○	○	○	○

ID 418

Please add any additional comments or reasoning

Future UK Civil Aerospace Supply Chain

ID 425

In this section of the survey we would like to understand your views on the opportunities and challenges that you feel may affect the civil aerospace supply chain now or in the future. Your responses will be used for analysis of the civil aerospace supply chain only. The views expressed will be aggregated into themes and direct contributions will not be passed onto BIS or any third parties.

25. Please identify whether the following elements may provide opportunities for, or threats to, the UK civil aerospace supply chain in the future.

	Opinion				
	Major Threat	Minor Threat	Minor Opportunity	Major Opportunity	Not sure
Production rate increases on existing aircraft programmes	○	○	○	○	○
Production rate slow down with older programmes	○	○	○	○	○
Future aircraft programmes (e.g narrowbody and widebody)	○	○	○	○	○
New entrant airframe manufacturers (e.g. Comac, Irkut)	○	○	○	○	○
New aircraft technologies (e.g. composite materials, more electric aircraft)	○	○	○	○	○
New manufacturing technologies (e.g. additive manufacturing technology)	○	○	○	○	○
Increased globalisation of aerospace supply chains	○	○	○	○	○
Second sourcing by prime contractors and Tier 1 suppliers	○	○	○	○	○
Shift of contracts from "build to print" to "design and build"	○	○	○	○	○

ID 381

Please add any additional comments or reasoning

ID 420

26. Please comment on any additional opportunities for the UK Civil Aerospace Supply Chain

ID 421

27. Please comment on any additional threats to the UK Civil Aerospace Supply Chain

Thank You!

ID 1

Thank you for taking our survey. Your response is very important to us.